NOVA SCOTIA Department of the Environment

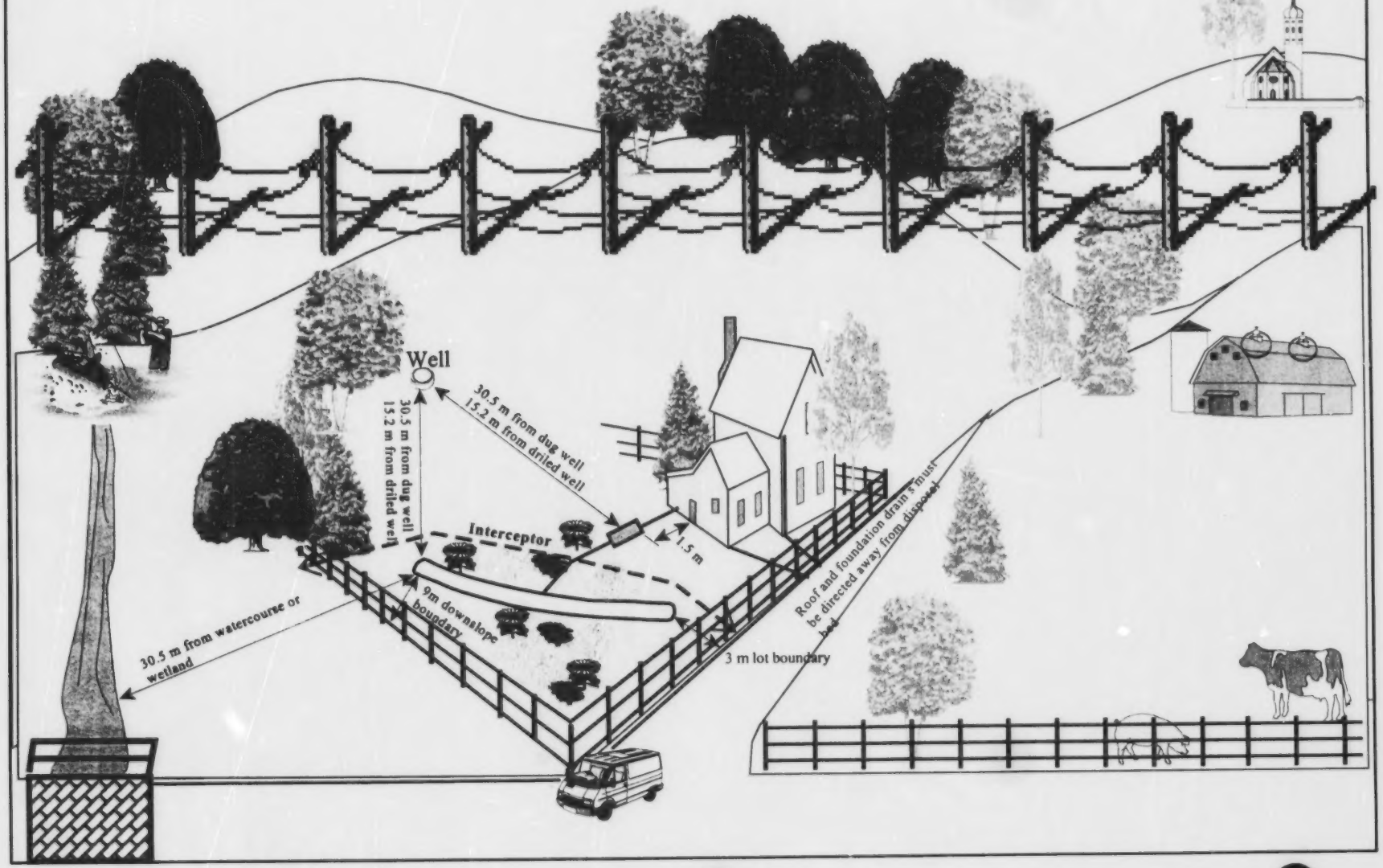
ON-SITE SEWAGE DISPOSAL SYSTEMS

TECHNICAL GUIDELINES

INTERIM

February 10, 2000

DISPOSAL BED INSTALLATION


Well
30.5 m from dug well
15.2 m from drilled well
30.5 m from dug well
15.2 m from drilled well
Interceptor
1.5 m
9m downslope boundary
30.5 m from watercourse or wetland
3 m lot boundary
Roof and foundation drain must be directed away from disposal bed

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SECTION 1

INTRODUCTION

1.1 PURPOSE OF THE GUIDELINES

These Guidelines have been established and adopted by the Nova Scotia Department of the Environment in accordance with *Regulations Respecting On-site Sewage Disposal Systems*, which became effective on June 10, 1997.

These Guidelines are not intended to be a comprehensive design manual covering every aspect of on site sewage disposal system design. There are numerous references available regarding soil hydraulics and other aspects of on site sewage disposal that can be of value to the designer.

The Regulations requires that design or selection of an on-site system take into account Guidelines, policies, or standards established or adopted by the Department.

These Guidelines include requirements that supplement those in the Regulations.

They also repeat, in summary or in whole, for the convenience of the user, relevant requirements of the Regulations. A user is cautioned that:

- if there is any uncertainty or ambiguity in comparing the Guidelines and Regulations, the Regulations govern.
- the Guidelines do not repeat some requirements of the Regulations, particularly those related to purely procedural matters.

The Guidelines are intended to be used as an educational and technical manual by qualified persons, installers of systems, staff of the Nova Scotia Department of the Environment, and others that have an interest in the planning, design, selection, installation, operation and maintenance of on-site systems.

Further information related to the Guidelines can be obtained from the regional offices of the Nova Scotia Department of the Environment.

1.2 CONTENT OF THE GUIDELINES

The content of the Guidelines reflects the fact that most on-site sewage disposal systems serve single unit residential dwellings. Section 4 deals with system selection and applies specifically to single unit residential systems and Section 5 deals with system design.

The information contained in the Guidelines, specifically Section 5, applies to the design of on-site systems that serve multi-unit residential, industrial, institutional and commercial properties.

The Guidelines also include information and instructions regarding; evaluation of sites to determine their suitability for on-site systems, system construction, operation and maintenance, and other topics that are listed in the Table of Contents.

1.3 INTRODUCTION TO ON-SITE SYSTEMS

This section provides a summary of some of the information regarding on-site systems that is provided in more detail in other parts of these Guidelines.

Figure 1.A shows a typical system, and indicates the role of different components in treatment and disposal of sewage and protection of public health and the environment.

A **building sewer** is the pipe that connects a building to the rest of a disposal system. This pipe must be the required size of 100 mm, watertight, and laid at a minimum slope of two percent. In some cases it may be necessary to pump wastewater from the building to a septic tank.

A **septic tank** is a settling tank that holds the sewage long enough — usually 48 hours—to allow for settling and floating solids, fats and greases to be removed. This prevents these materials from clogging the disposal field and the surrounding soil. The tank also provides storage for sewage solids, and allows them to partially decompose. The tank will hold about a 3-year accumulation of solids in normal use, after which the tank should be pumped. Septic tanks must be watertight—to prevent sewage from escaping, and to prevent ground water from entering and occupying space intended for the treatment of sewage. They must also be accessible for maintenance and repair.

Septic tank effluent (sewage leaving the tank) will contain reduced concentrations of settlable or floatable solids, but it will still be contaminated by fecal bacteria and fine organic solids.

An **effluent line** is the pipe that connects the septic tank to a disposal field. In some cases it may be necessary to pump effluent to the disposal field.

A **disposal field** is intended to distribute septic tank effluent into the soil, and may provide treatment of the effluent.

Components of a disposal field (**Figure 1.A**) include:

- **Sod** over a disposal system is essential, because it provides frost protection, protects against erosion, sheds surface water, and stores water that does soak in to the soil until it evaporates or is returned to the atmosphere by plants.
- **Clean local backfill** supports the sod. It also provides frost protection, storage for surface water until it evaporates, and allows oxygen and other gases to pass into and out of the disposal field.
- A synthetic **barrier material** prevents clean local backfill material from migrating into the crushed rock and clogging the disposal field.
- Most systems use **gravity distribution pipe**, with a slope and hole spacing intended to evenly distribute the effluent. For longer systems or systems that cannot be gravity fed, **pumps or siphons and pressure distribution piping** will be necessary.

- **Crushed rock** surrounds the distribution pipe and distributes effluent from the septic tank over the disposal area. It provides protection for the distribution pipe and storage and distribution of the effluent.

- **Filter sand** beneath the crushed rock provides a location for the formation of the **clogging mat**, which will form after several months of system operation. The clogging mat is a layer of solids, consisting of solids from the septic tank effluent microbiological organisms and their by-products. The microorganisms digest the organic materials in the effluent. The clogging mat has a very low permeability, and, at periods of high flow, effluent will pond within the distribution field (i.e. the gravel layer) in order to generate enough pressure to force the effluent through the clogging mat and into the surrounding soil.

- The **infiltrative surface** is the top of the natural soil beneath the field. Care must be taken during construction to prevent damage to this surface, which could block soil pores and prevent effluent from entering the soil.

- The **soil** beneath the disposal field plays an important role in determining the design and the size of on-site fields. The soil removes harmful pathogens before the effluent reaches ground water, which may supply a well or re-appear in a stream or lake. As effluent from a disposal field passes through a silty soil, particulate matter is physically filtered out in a relatively short distance. Most bacteria, viruses or other potentially disease-causing organisms (pathogens) are not able to pass through long distances of unsaturated soil. They are retained within the first few feet of soil, where the numbers are greatly reduced in a hostile environment. In saturated soils the organisms may travel much greater distances. When effluent enters a heavy gravel with little or no fine material (silt and clay particles), it will pass through the voids so quickly that pathogens can be transported hundreds of feet.

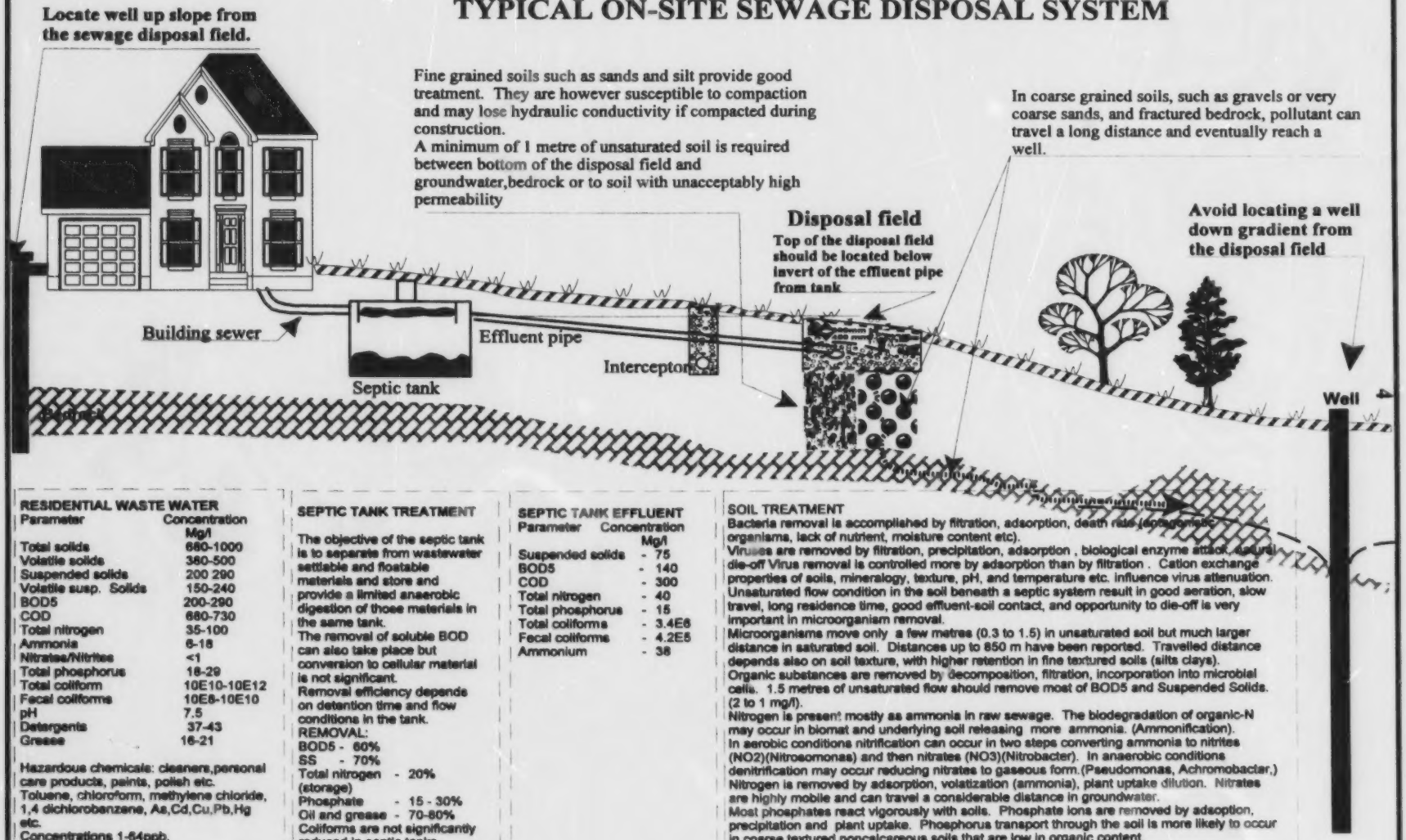
For all systems, a minimum soil thickness is maintained between the bottom of the disposal field and ground water or bedrock, which may contain fractures or openings that can carry effluent into the ground water. If the natural soil is too coarse to provide this protection, a built-up disposal system must be designed to include an additional sand layer (**imported sand fill material**) over the coarse soil. In situations where the natural soil is so tight that effluent will travel horizontally before it can slowly enter the soil, selection/design of the system focuses on provision of an adequate distribution area.

Surface water and roof drainage should be directed away from a disposal field. Surface and ground water entering a disposal system can cause the hydraulic capacity of the field to be exceeded. For this reason some locations should be avoided for siting of a disposal field. In many locations an **interceptor drainage system (Figure 1.B)** will be required to divert surface water and/or lower a water table.

In some situations the typical system(**Figure 1.A**) may not be appropriate, and alternatives that are permitted by the Regulations and comply with these Guidelines may be used.

FIGURE 1.A

TYPICAL ON-SITE SEWAGE DISPOSAL SYSTEM


Locate well up slope from the sewage disposal field.
Fine grained soils such as sands and silt provide good treatment. They are however susceptible to compaction and may lose hydraulic conductivity if compacted during construction.
A minimum of 1 metre of unsaturated soil is required between bottom of the disposal field and groundwater,bedrock or to soil with unacceptably high permeability
In coarse grained soils, such as gravels or very coarse sands, and fractured bedrock, pollutant can travel a long distance and eventually reach a well.
Disposal field
Top of the disposal field should be located below invert of the effluent pipe from tank
Avoid locating a well down gradient from the disposal field
Building sewer
Effluent pipe
Interceptor
Septic tank
Well

RESIDENTIAL WASTE WATER

Parameter	Concentration Mg/l
Total solids	660-1000
Volatile solids	380-500
Suspended solids	200 290
Volatile susp. Solids	150-240
BOD5	200-290
COD	660-730
Total nitrogen	35-100
Ammonia	6-18
Nitrates/Nitrites	<1
Total phosphorus	18-29
Total coliform	10E10-10E12
Fecal coliforms	10E8-10E10
pH	7.5
Detergents	37-43
Grease	16-21

Hazardous chemicals: cleaners,personal care products, paints, polish etc.
Toluene, chloroform, methylene chloride, 1,4 dichlorobanzene, As,Cd,Cu,Pb,Hg etc.
Concentrations 1-64ppb.

SEPTIC TANK TREATMENT

The objective of the septic tank is to separate from wastewater settlable and floatable materials and store and provide a limited anaerobic digestion of those materials in the same tank.
The removal of soluble BOD can also take place but conversion to cellular material is not significant.
Removal efficiency depends on detention time and flow conditions in the tank.
REMOVAL:
BOD5 - 60%
SS - 70%
Total nitrogen - 20% (storage)
Phosphate - 15 - 30%
Oil and grease - 70-80%
Coliforms are not significantly reduced in septic tanks.

SEPTIC TANK EFFLUENT

Parameter	Concentration Mg/l
Suspended solids	- 75
BOD5	- 140
COD	- 300
Total nitrogen	- 40
Total phosphorus	- 15
Total coliforms	- 3.4E6
Fecal coliforms	- 4.2E5
Ammonium	- 38

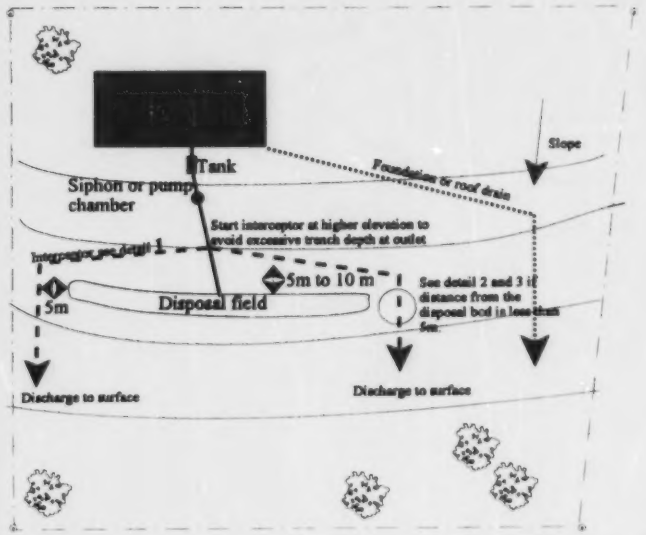
SOIL TREATMENT

Bacteria removal is accomplished by filtration, adsorption, death rate (competitive organisms, lack of nutrient, moisture content etc).
Viruses are removed by filtration, precipitation, adsorption , biological enzyme attack, natural die-off Virus removal is controlled more by adsorption than by filtration . Cation exchange properties of soils, mineralogy, texture, pH, and temperature etc. influence virus attenuation.
Unsaturated flow condition in the soil beneath a septic system result in good aeration, slow travel, long residence time, good effluent-soil contact, and opportunity to die-off is very important in microorganism removal.
Microorganisms move only a few metres (0.3 to 1.5) in unsaturated soil but much larger distance in saturated soil. Distances up to 850 m have been reported. Travelled distance depends also on soil texture, with higher retention in fine textured soils (silts clays).
Organic substances are removed by decomposition, filtration, incorporation into microbial cells. 1.5 metres of unsaturated flow should remove most of BOD5 and Suspended Solids. (2 to 1 mg/l).
Nitrogen is present mostly as ammonia in raw sewage. The biodegradation of organic-N may occur in biomat and underlying soil releasing more ammonia. (Ammonification).
In aerobic conditions nitrification can occur in two steps converting ammonia to nitrites (NO_2)(Nitrosomonas) and then nitrates (NO_3)(Nitrobacter). In anaerobic conditions denitrification may occur reducing nitrates to gaseous form.(Pseudomonas, Achromobactar,)
Nitrogen is removed by adsorption, volatization (ammonia), plant uptake dilution. Nitrates are highly mobile and can travel a considerable distance in groundwater.
Most phosphates react vigorously with soils. Phosphate ions are removed by adsoption, precipitation and plant uptake. Phosphorus transport through the soil is more likely to occur in coarse textured noncalcareous soils that are low in organic content.

For general information only

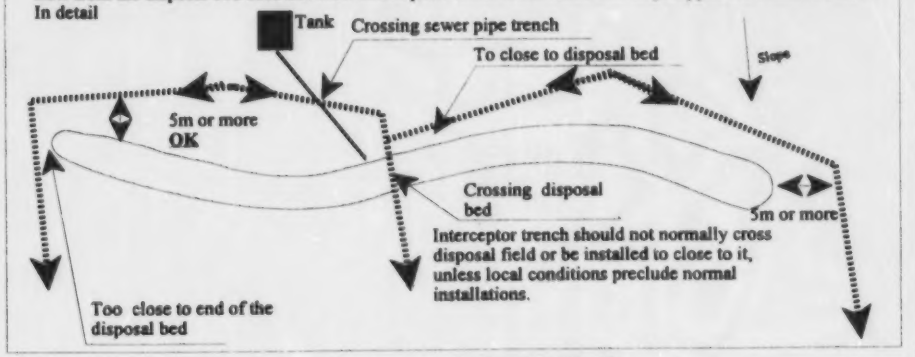
FIGURE 1.B

INTERCEPTOR


Tank
Siphon or pump chamber
Slope
Foundation or roof drain
Start interceptor at higher elevation to avoid excessive trench depth at outlet
Interceptor see detail 1
5m to 10 m
5m
Disposal field
See detail 2 and 3 if distance from the disposal bed is less than 5m.
Discharge to surface
Discharge to surface

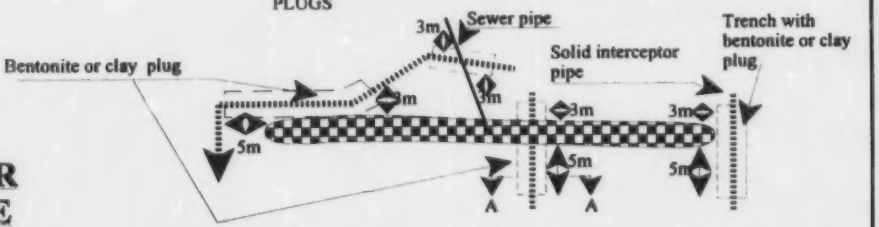
POTENTIAL PROBLEM AREAS AT INTERCEPTOR LOCATION

Special precaution must be take n to ensure that water from the interceptor does not enter the disposal system or flow from the disposal bed does not enter interceptor. Some areas where this may happen are outlined below.


In detail
Tank
Crossing sewer pipe trench
To close to disposal bed
Slope
5m or more
OK
Crossing disposal bed
5m or more
Interceptor trench should not normally cross disposal field or be installed to close to it, unless local conditions preclude normal installations.
Too close to end of the disposal bed

DETAIL 2

LOCATION AND EXTENSION OF BENTONITE/CLAY PLUGS



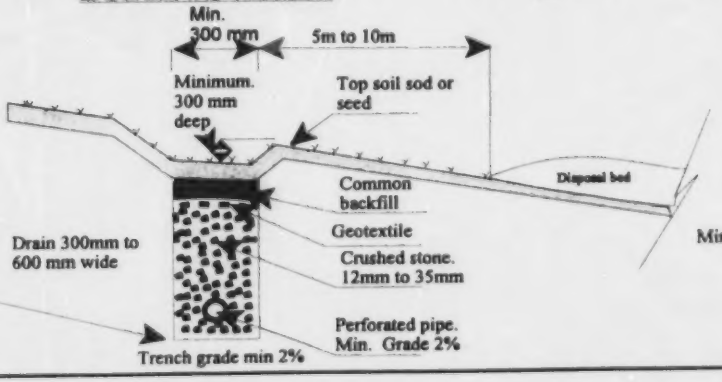
NOTES:

Foundation and roof drains must not be connected to interceptor drain or discharge in vicinity of disposal field, septic tank or pump chamber

Interceptor drain should be extended minimum of 6 m below end of the buffer . It must provide an unobstructed discharge to the surface.

A lot should be graded to keep runoff away from disposal field, septic tank or pump chamber.

DETAIL 1
INTERCEPTOR DRAIN/SWALE


Min. 300 mm
5m to 10m
Minimum. 300 mm deep
Top soil sod or seed
Disposal bed
Common backfill
Geotextile
Drain 300mm to 600 mm wide
Crushed stone. 12mm to 35mm
Bottom of the interceptor below bottom of the disposal trench
Perforated pipe. Min. Grade 2%
Trench grade min 2%

DETAIL 3
A-A

Under sewer line fill up to the sewer pipe. Under distribution field fill to the bottom of the field.

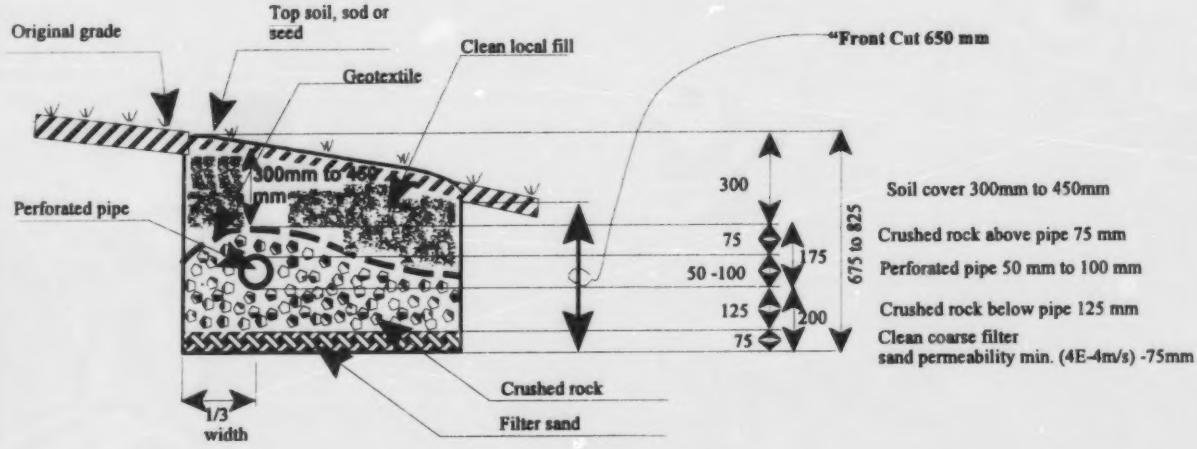
Min 500 mm
Impermeable backfill, 5 to 10% compacted bentonite powder as per manufacturers instructions. Compacted clay.
Solid interceptor pipe
450 mm Max

FIGURE 1.C

TYPICAL CONTOUR SYSTEM CROSS-SECTION

[All dimentions in milimeters (mm)]

C1



C1 raised

Extend buffer minimum 1 meter on each side of the trench.
Provide top soil ,sod or seed over entire bed.

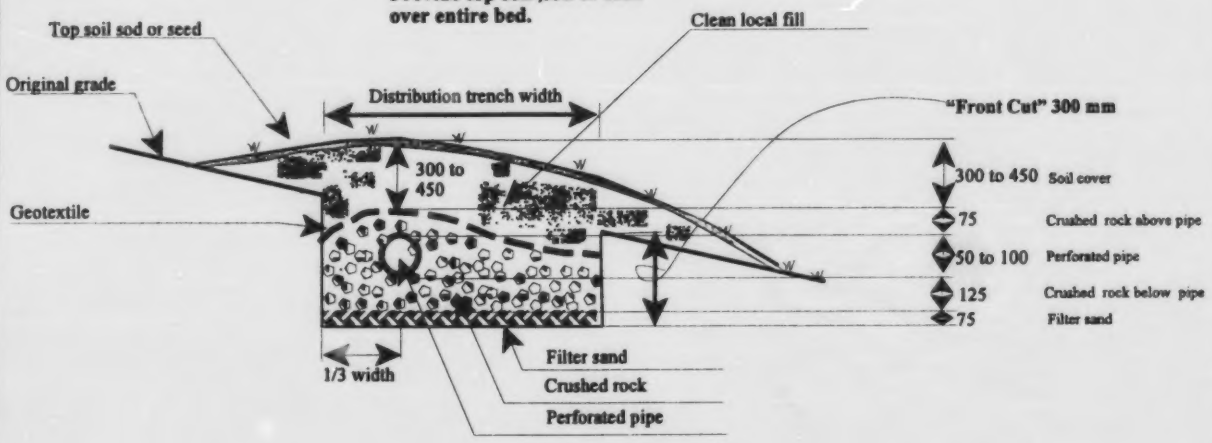
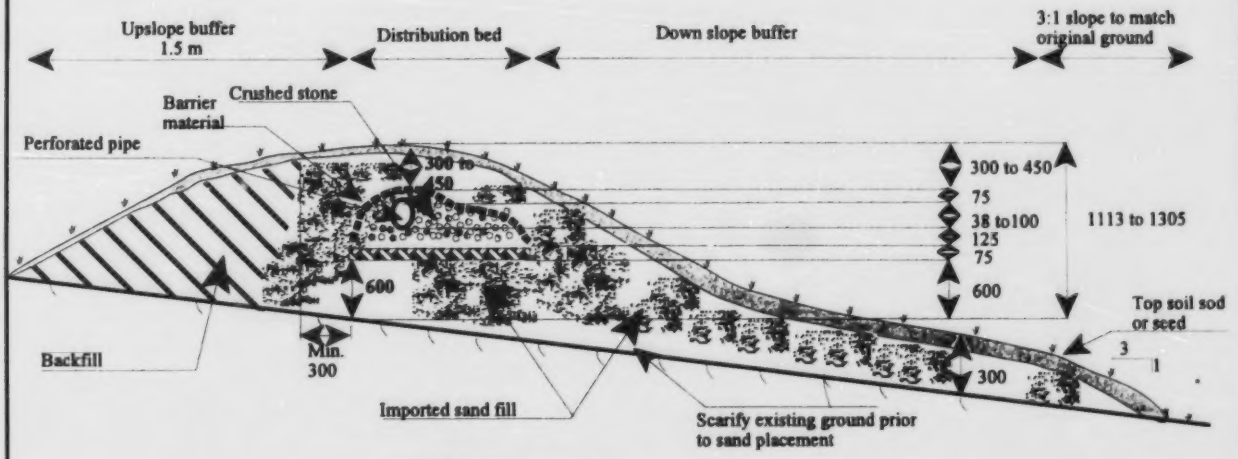
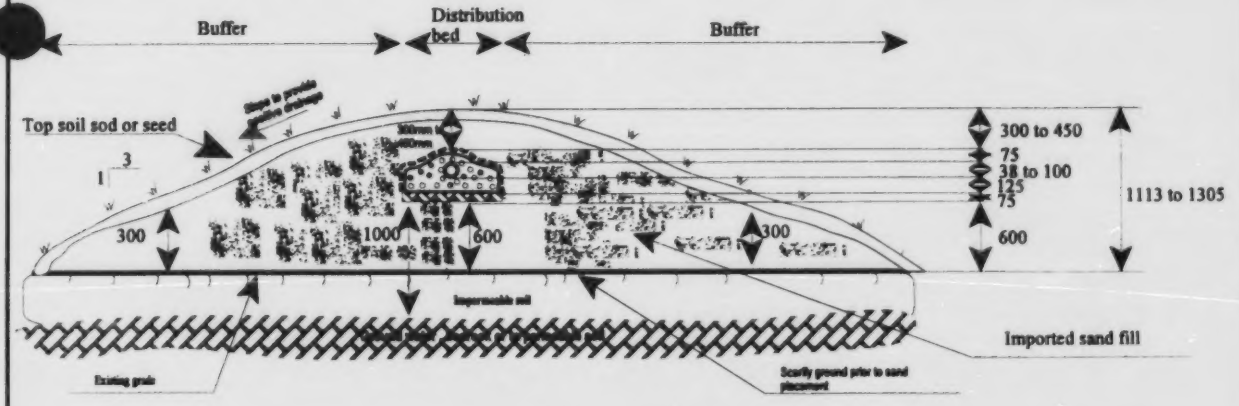


FIGURE 1C continued
All dimensions in millimetres (mm)
Minimum required

C3



MOUND



AB or MT

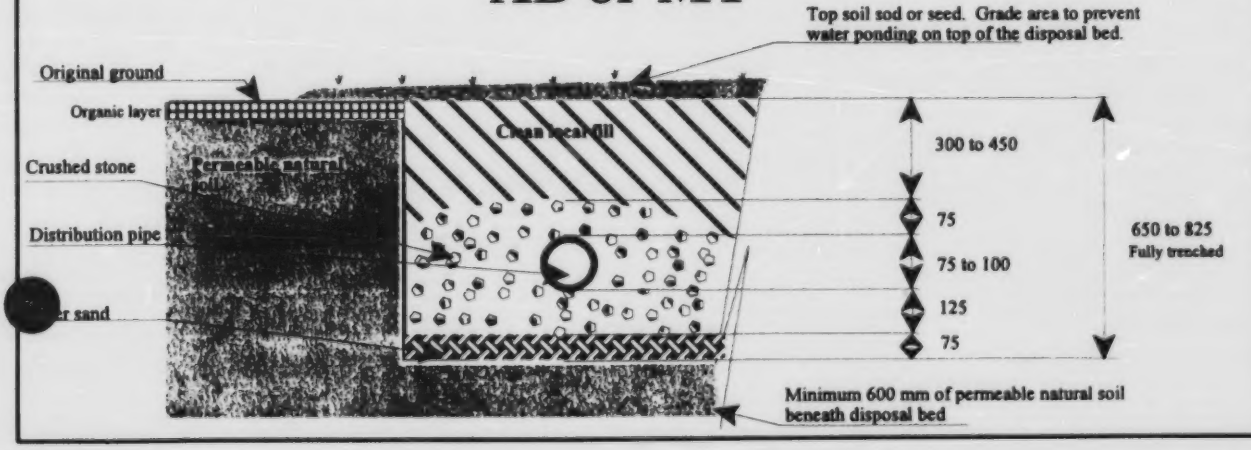


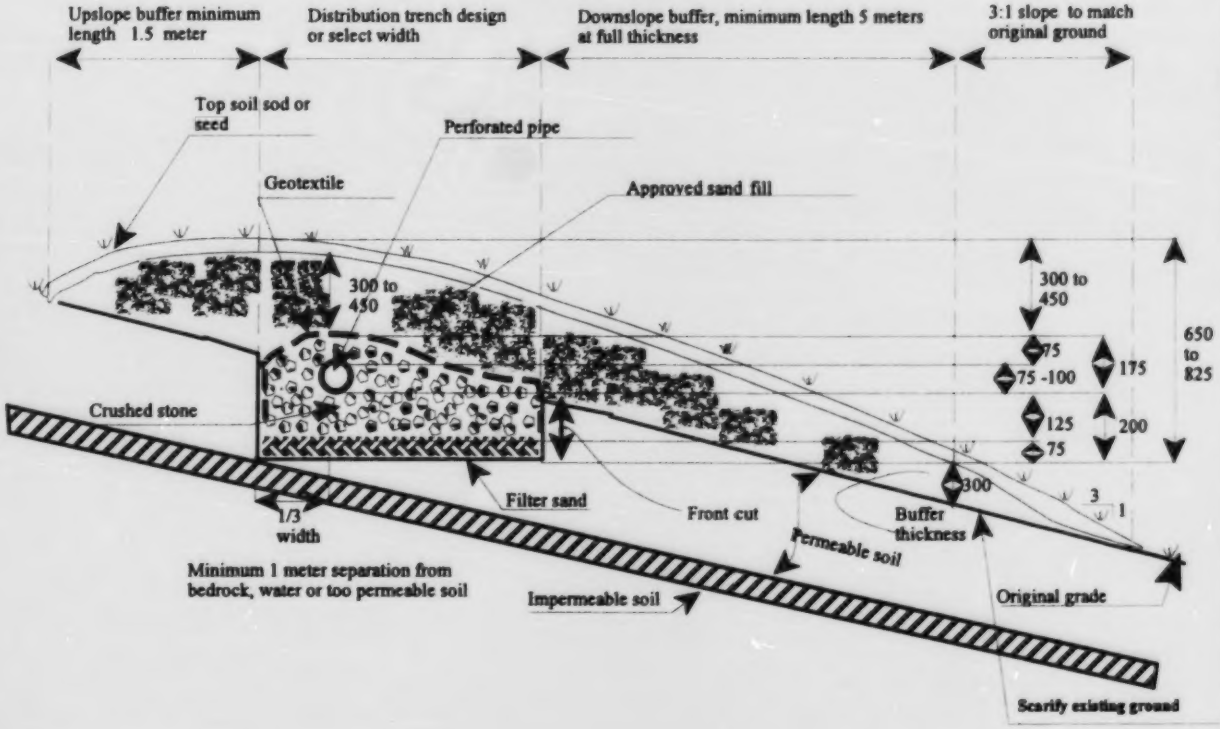
FIGURE 1.C continued

All dimentions are minimum required

TYPICAL SYSTEM CROSS- SECTION

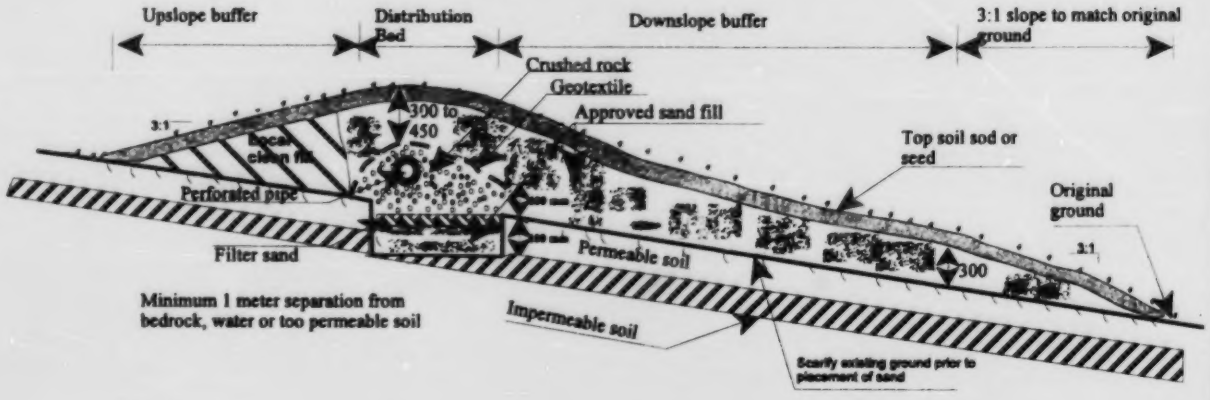
[All dimensions in millimetres (mm)]

C2



C2 raised

Cross-section dimensions are the same as above unless otherwise stated.



1.4 CARE OF ON-SITE SYSTEMS

Proper routine maintenance is a key to long term satisfactory operation of an on-site sewage disposal system. This is the responsibility of the owner. Unfortunately, too few people realize the importance of regular maintenance and it is only carried out when a problem arises and irreversible damage has been done to the system. Some people purchase homes with on-site disposal systems and do not even know such a system exists until they have problems.

Lack of maintenance can result in system malfunctions and costly repairs. Evidence that an on-site system has been properly maintained and protected may significantly assist in resale of a property.

Most on-site systems are intended to perform reliably with minimal attention except regular but infrequent inspection and pumping of the septic tank. The following sections provide advice about the maintenance and care of an on-site system.

1.4.1 What Should Not Go Down the Drain

An on-site sewage disposal system consisting of a septic tank and disposal field is designed to handle all normal household waste waters. The disposal system can handle body wastes, wash water and laundry wastes including moderate amounts of bleach.

However, it is important that the property owner recognize that for trouble free-operation of these systems there are limits on materials that can be discharged to an on-site system, and on the amount of sewage a system can handle.

Table 1.1 includes examples of materials that can affect the performance of an on-site system because they:

- cannot be treated by an on-site system, and may contaminate water supplies or the environment and/or
- will affect the performance of the system, and result in extra maintenance or repair, or require system replacement.

Garbage grinders should not be installed unless the size of the septic tank is increased by 20 percent to handle the additional load of solid materials.

Backwash water from water treatment devices should not be discharged to the system.

Septic tank additives are not needed for proper operation of a septic tank, and may damage the septic tank and disposal field and contaminate ground water. Use of additives that cause solids to be washed from a septic tank into a disposal field may result in clogging of the field, with the result that it may need to be replaced.

Facilities such as restaurants must have grease chambers. Grease chambers must be placed ahead of the septic tank and properly sized. The grease must be physically removed. Chemical compounds used to dissolve grease must not be added to grease traps. They will clean out the trap, but the dissolved grease may resolidify in the disposal field, causing failure of the system.

TABLE 1.1

DO'S and DON'T'S IN THE USE OF AN ON-SITE SYSTEM

Do's	Don'ts
Do spread automatic washer use over the week rather than many loads on one day.	***Don't*** overload the system with high volumes of water.
Do make a permanent record of where the key parts of your system are located for future maintenance, such as tank pump outs or field repairs.	***Don't*** discharge water treatment backwash to the on-site system.
Do keep records of pump outs and maintenance.	***Don't*** allow large amounts of fats, plastics, chemicals or solvents to enter the system.
Do use water conserving devices where possible. Low flush toilets and shower heads are commonly available.	***Don't*** enter a septic tank without proper ventilation. Sewer gases can be fatal.
Do have manually cleaned lint traps on your automatic washer.	***Don't*** allow vehicles or heavy equipment to drive over the disposal field. This may compact the soil or crush the piping.
Do have your septic tank pumped out regularly.	***Don't Flush:***
Do check any pumps, siphons or other moving parts regularly.	coffee grounds, disposable diapers, sanitary napkins, cigarette butts, paints, thinners, photographic chemicals, other chemical wastes, dental floss, kitty litter, tampons, condoms, varnishes, pesticides, waste oils
Do remove or prevent trees with large root systems growing near the disposal field.	
Do maintain a healthy grass cover over the disposal field to prevent erosion and encourage water evapotranspiration.	
Do keep surface water from up slope or roof drains away from the disposal field.	
Do check your interceptor drain regularly to ensure that it is free flowing.	

1.4.2 Water Use and Conservation

The minimum design capacity of a residential on-site system, which could include seasonal, rental units, is 1000 litres/day.

Systems for larger dwellings, dwellings with fixtures such as hot tubs that use additional water, and commercial establishments, must be appropriately designed for higher flows.

Problems can result if the design capacity is exceeded, because the excess flow can wash out solids from a septic tank (which can clog a disposal field), or because the excess flows can exceed the hydraulic capacity of the field. Ways to avoid these problems, in new and existing buildings, include:

- fix leaking plumbing fixtures
- distribute water use where possible, e.g., use the clothes washer once each day rather than many times on a single day
- reduce normal water use in showers and sinks
- install water conserving fixtures, especially ultra-low flush toilets
- assure that the septic tank is watertight
- assure that the system is located and protected to avoid unnecessary surface water, ground water, or roof drainage.
- install, and regularly record the water meter, which can detect leaking fixtures or excessive water use that can overload a system.

If the area near the disposal field appears to be saturated during wet times of the year, it may be necessary to reduce water usage by adopting one of the measures listed above. See Section 7 for more details.

1.4.3 Maintenance

If septic tanks are not cleaned regularly, excess accumulated solids will be carried into the disposal field and may result in irrepairable soil clogging. The solids may also clog the tank inlet or outlet and cause sewage to back up into the building.

The average septic tank should be pumped about once every three years, depending on the degree of use and the nature of materials that enter the system. Routine inspection may indicate that an individual tank can be pumped less frequently; tanks that are heavily used or abused may need to be pumped much more often.

Never enter a septic tank. It could be fatal ! If it is necessary you should consult the Department of Labour for their procedures on Confined Spaces.

Grease traps should be inspected regularly. If the chamber is half full, it should be pumped by a registered septic tank pumper.

Operation of pumps and siphons should be routinely checked.

The sod cover over the disposal field should be maintained, to prevent erosion, and reduce the amount of precipitation or runoff that enters the field.

Large trees should be removed from the immediate area of the disposal field to prevent roots from clogging the pipes, providing channels for short circuiting of effluent, or damage to the system if the tree is uprooted.

Tanks in seasonal systems should not be emptied prior to the winter season, because of the possibility that they may be damaged by frost.

1.4.4 Access, Protection, and Other System Features

The owner of any on-site system should know, or find out, where the septic tank and disposal field are located.

The Regulations require that watertight access be provided for inspection, maintenance, and pump out of a septic tank. This may require a watertight riser and cover to bring the access opening close to the ground surface. Owners of existing systems that are not easily accessible should consider installing easier access. Section 3 of these Guidelines provides information about risers and covers for septic tanks.

Vehicular traffic should not be allowed to travel over a disposal system, because of the risk that distribution pipes may be crushed, or the field damaged.

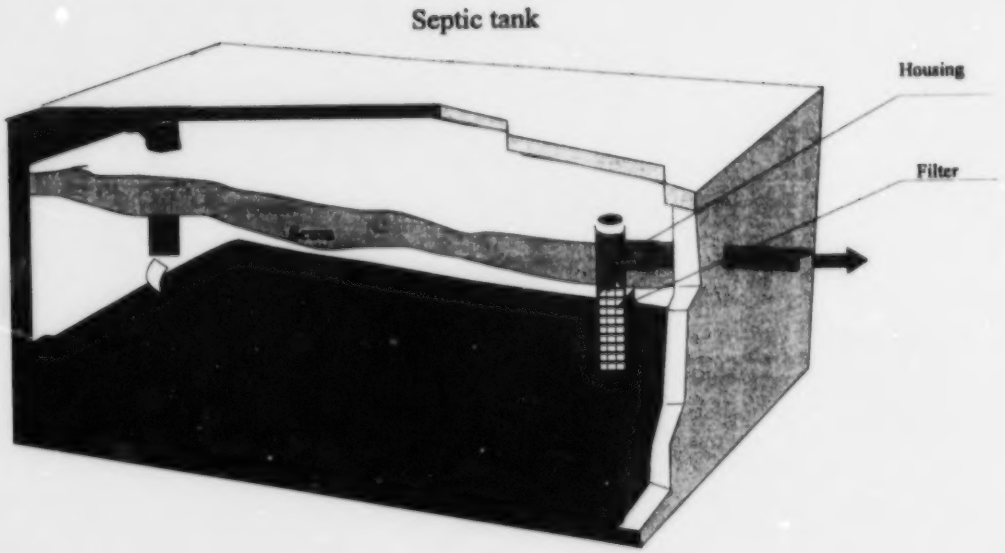
Prospective and existing owners, and those who design and select systems, should consider features that can improve the performance and assist inspection of on-site systems:

- Septic tank filters are designed to intercept solids that might otherwise escape from a septic tank and block a disposal field. They are expected to require regular cleaning when the septic tank is inspected or pumped. If they require more frequent cleaning, it is assumed that the materials that blocked the filters would otherwise have reached the disposal field, causing potentially serious and expensive damage.**(Figure 1.D)**
- Inspection ports installed in a disposal system allow for periodic inspection of effluent levels in the system, and can help to anticipate and diagnose problem.
- A water meter will allow the home owner to compare actual water use with the capacity of the system, and help to guide decisions about water conservation.

These devices are not currently required in the Regulations but maybe stipulated in an approval. They are inexpensive compared with the cost of the system, or of system repair and replacement.

FIGURE 1.D

EFFLUENT FILTER



NOTES:

Effluent filters are provided to reduce solids load to the disposal field. They usually consist of a plastic screen or mesh through which the effluent must pass before flowing to the disposal field. This prevents the passage of large particles and also slows the flow velocity to allow better settling of smaller particles.

Filters are usually installed in the Tee at the outlet from the septic tank.

Depending on the design, they filter out particles larger than 1.5 mm to 3mm.

According to manufactures information filters can reduce TSS by 50% to 90% and BOD by 30% to 60%.

Filters must be selected and maintained according to manufactures guideline depending on hydraulic and organic load.

SECTION 2

2. SITE ASSESSMENT

2.1 INTRODUCTION

Site assessment includes evaluation of a lot at the subdivision stage, or at the time that an on-site system is selected or designed.

This section of the Guidelines outlines:

- approval procedures, including information that must be assembled and reported
- site assessment reports
- basic considerations that are involved in assessment of a lot
- soil assessment
- determination of minimum area and width of a lot
- minimum clearance distances from wells, boundaries, and other features.

Later sections of the Guidelines deal with selection and design of systems.

2.2 APPROVAL PROCEDURES

When a property is subdivided, or when approval is sought to construct or install an on-site system, information about the site and the proposed system must be submitted, by a subdivide or a person proposing to install an on-site system.

2.2.A When a property is subdivided:

1. A subdivide must submit documentation to the development officer that includes:
   a. a plan or sketch of each lot, showing specified information that is listed below.
   b. an explanation of the extent, volume, and type of usage to which the on-site system will be subjected.
   c. an assessment report of the lot respecting its suitability to support an on-site system, including the results of a soil evaluation test.
   d. any other information required by an inspector.
   e. proof of ownership.

2. The assessment report must be prepared by a qualified person or the Department.

3. The lot size and width must satisfy requirements of Schedule "A"of the *On-Site Sewage Disposal Systems Regulations*.

4. Submission Standards must be in accordance with the Departments " Submission Standards for Applications", referred to as **Appendix J**.

5. The role of the Department is to determine whether the lot(s) are suitable based on the information provided.

2.2.B When an application is made to construct or install a system:

1. The applicant must complete and submit the "Submission Standards for Applications form" or a form that includes:

   a. the information listed in 2.2.A.1
   b. information listed on the "Submission Standards Document"
   c. information about the proposed water supply on the lot and existing supplies on adjacent properties.
   d. locations that indicate compliance with clearance distances.
   e. details indicating that selection/design specifications in the Regulations and Guidelines are met.
   f. any other information required by an inspector, which may include a plan of survey.

2. The assessment report is required if one was not previously prepared or is no longer applicable because of changed site conditions.

3. The assessment report, and information in part 1 c & d above, must be prepared by a qualified person or may be prepared by the Department upon written request.

The plan or sketch of a lot that is submitted by a subdivide, or applicant to construct or install a system, must include:

(i) lot dimensions and area
(ii) lot layout, including buildings, proposed system, proposed driveway, and wells
(iii) location of features that may influence the design of the system, including watercourses, wetlands, wells, ditches, roads, and driveways
(iv) surface slopes and directions
(v) design capacity of the on-site system and;
(vi) must be in accordance with the Departments " Submission Standards for Applications **(Appendix J)**

This information will also be required by a qualified person or an inspector who prepares an assessment report or selects or designs an on-site system.

2.3 SITE ASSESSMENT REPORTS

A site assessment report that is required at the subdivision or system approval stage deals with the suitability of a site to support an on-site system, and must include results of a soil evaluation test at the location of the proposed disposal field.

The site assessment must therefore take into consideration all of the information that is detailed in Section 2.

2.4 BASIC CONSIDERATIONS IN SITE ASSESSMENT

Basic considerations in the assessment of a site(s), for their suitability to install an on-site system include:

- slopes and surface drainage
- bedrock
- changes in grade
- watercourses and wetlands
- traffic areas
- types of natural vegetation
- well locations
- soil assessment
- groundwater elevation

Each of these considerations is discussed below. **Table 2.5** lists other features that should be identified and located during assessment of a lot.

2.4.1 Slopes

There are exceptions, but the typical soil type in Nova Scotia is glacial till with increasing compaction with depth. The top few feet of soil are typically more permeable than subsequent depths due to root penetration, weathering, etc. As a result, water either from rainfall or from an on-site sewage disposal system, tends to flow downslope through this permeable layer until such time as it is able to penetrate the deeper soil, evaporate, break to the surface, or enter a watercourse.

Steep slopes in combination with poor soil conditions make the design, installation and operation of an acceptable on-site disposal system difficult or even unacceptable. For example, a system installed in a very shallow soil on a lot with a steep slope is more likely to malfunction than a system in similar soil conditions on a lot with only a moderate slope.

Surface slopes also affect the type of on-site system that can be installed. **Table 4.2** lists maximum and minimum slopes that apply to systems discussed in these Guidelines.

The location of a disposal system on a slope is important. Groundwater moving down the slope too near the surface can be contaminated by intercepting the effluent before the latter is adequately treated. Run-off from up-slope areas may flood the disposal field.

Thus poorly drained soils, shallow soils, areas of high groundwater level or areas receiving large volumes of run-off should be avoided.

Assuming all other parameters are constant, the best location for a system on a slope is at or near the crest. Areas further down the slope may require upslope interceptor trenches to catch and divert surface run-off and/or groundwater away from the disposal field. **(Figure 1.B)**.

The overall slope on the lot also can affect the foundation elevation, whether or not pumping is required, and the type and design of the disposal system. For example, on a lot with little slope, plumbing could not be installed in a full basement without pumping to the disposal system. However, on a sloping lot pumping may not be necessary. A long narrow system installed parallel to the contour is preferred on a sloping lot. It not only blends into existing grades, but spreads the effluent across a longer slope interface and as a result is more likely to function satisfactorily.

2.4.2 Bedrock

If untreated effluent enters fractures in bedrock, it can easily contaminate wells hundreds of feet away. Rock outcrops on a lot may indicate limited soil cover over bedrock. The depth of bedrock is a key consideration in determining the type of system which may be placed on the property. The *On- Site Sewage Disposal Systems Regulations* require a minimum vertical separation distance of 1 metre between the bottom of the disposal trench and any bedrock.

2.4.3 Changes in Grade

Distance from a disposal system to abrupt changes in grade is also an important consideration on a lot. Effluent from the system may break out at the surface if it has not already entered the subsoil. Adequate separation distances from breaks in slope (cliffs, banks, etc.) are therefore required. **(Table 2.5)**.

2.4.4 Watercourses and Wetlands

Contamination of watercourses and wetlands can threaten public health (e.g. swimming areas or water supplies) and/or the environment. **(Table 2.5)**

2.4.5 Traffic Areas

Care should be taken to avoid pre-existing roads or traffic areas on a lot for the location of the disposal field, because soil compaction can severely limit the operation of the field.

Heavy machinery should be kept off the disposal field and the immediate downslope area during construction. Automobiles and all heavy traffic should be kept off the completed disposal field to avoid crushed pipes, broken joints, or soil compaction.

2.4.6 Type of Natural Vegetation

An assessment of the vegetation type on a lot may give an indication of the soil conditions. The presence of alders and rushes may be evidence that a lot has saturated soils.

2.4.7 Well Locations

Locations and types of existing or proposed wells on the lot, or existing wells on adjacent properties, must be determined and taken into consideration in siting an on-site system.

2.5 SOIL ASSESSMENT

Assessment of soil conditions is the most important consideration in site evaluation and system selection or design.

2.5.1 Soil Assessment Methods

Soil assessment involves:

- Examination of test pits
- Testing of soil permeability

2.5.1.a Test Pits

Test pits provide information about the soil profile at the proposed location of a disposal field. This information must include the following: **(Figure 2A)**

- Organic layer
- Total soil depth
- Effective soil depth
- Total depth of test pit
- Root penetration
- Depth to bedrock
- Depth to layer of soil with unacceptable permeability (refer to **Table 2.1**)
- Determination of highest seasonal water table
  - Presence and depth of mottling
  - Depth to water
  - Moisture content (saturated, moist, dry, etc.)
  - Perched water table
- Soil profile:

- Description of soil (including all soil from unacceptably high to unacceptably low)
- Depth of each layer
- Texture of soil **(Table 2.2)**
- Moisture content (saturated, moist, dry, etc.)
- Density (loose, medium, compact, tight)
- Colour
- structure

For safety, the pit should be no more than 1.2 m deep, with sloping sides and an entrance ramp for easy access and escape in the event of a soil slide. All soil removed from the pit should be placed a minimum of 1 m from the edge of the pit. If the pit is dug by backhoe and verification of subsoil conditions is required, the pit may be taken to a greater depth, but inspection should be carried out from the surface with the aid of samples of soil recovered by the machine bucket. A soil profile can then be recorded based on the variation in soil characteristics with depth.

ALL TEST PITS MUST BE DUG IN COMPLIANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS OF THE DEPARTMENT OF LABOUR.

2.5.1.b In-situ Permeability Tests

These tests can be used to confirm the estimation of soil permeability based on the visual assessment of soil properties in the test pit. When using these tests to verify results, a minimum of three tests should be done. If the tests are not of similar order of magnitude, more tests should be conducted.

These tests may also be used for the:

- Determination of a particular sandy gravel as a soil with acceptable or unacceptably high permeability.
- Determination of a particular soil as an unacceptably low or an impermeable soil.
- Confirmation of visual assessment of soils for higher flow systems, such as commercial and institutional buildings.

An example of an in-situ test is provided in **Appendix C.** Other in-situ tests can be used, provided they are approved by the Department.

2.5.2 Soil Types

Assessment of soil in which on-site systems are to be installed must recognize two roles that soils play in the performance of these systems

- Providing a pathway for effluent to move away from the disposal field.
- Removal of some contaminants as effluents pass through the soil.

Table 2.1 summarizes the permeability of each soil type. **Appendix D** provides additional information about the movement of water through soils.

The depth of permeable soil is critical in the determination of minimum lot dimensions. A **permeable soil** is defined in the *On-Site Sewage Disposal Systems Regulations* as a soil with a saturated hydraulic conductivity (permeability) between 0.000003 and 0.0008 m/sec. **Table 2.1**, which lists values of permeability for various soil types, indicates soils that this definition would include as:

- medium to course sand
- fine sandy gravel
- silty sand
- sandy silt

Natural soils with permeabilities greater than .0008 m/sec are considered to have unacceptably high permeability and are so coarse that they may permit the passage of contaminants. These include:

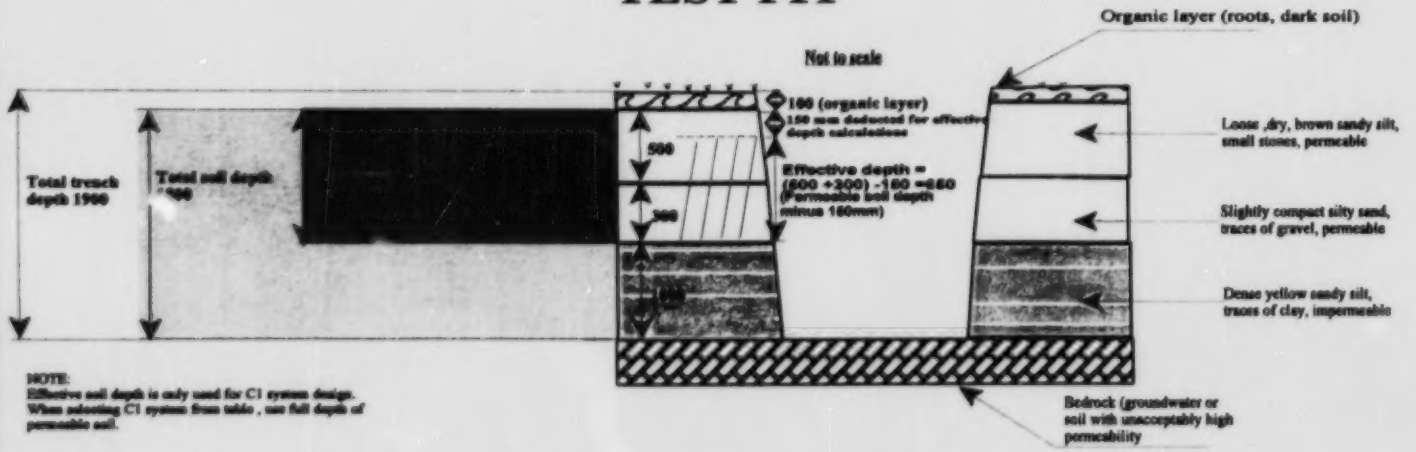
- rock, clean gravel

Natural soils with permeabilities less than 0.000003m/sec are considered to have unacceptably low permeability. These include:

- clayey silt
- silty clay
- clay

FIGURE 2.A

TEST PIT


Organic layer (roots, dark soil)
Not to scale
160 (organic layer)
160 mm deducted for effective depth calculations
Total trench depth 1900
Total soil depth =900
500
300
Effective depth = (600 +300) -160 =860 (Permeable soil depth minus 160mm)
Loose ,dry, brown sandy silt, small stones, permeable
Slightly compact silty sand, traces of gravel, permeable
Dense yellow sandy silt, traces of clay, impermeable
NOTE:
Effective soil depth is only used for C1 system design. When selecting C1 system from table , use full depth of permeable soil.
Bedrock (groundwater or soil with unacceptably high permeability

21

INFLUENCE OF TOPOGRAPHY

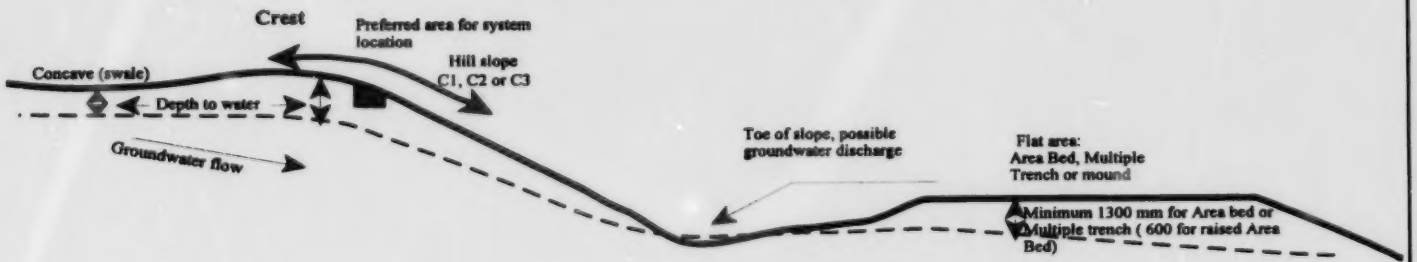

Crest
Preferred area for system location
Hill slope C1, C2 or C3
Concave (swale)
Depth to water
Groundwater flow
Toe of slope, possible groundwater discharge
Flat area: Area Bed, Multiple Trench or mound
Minimum 1300 mm for Area bed or Multiple trench (600 for raised Area Bed)

TABLE 2.1

A GUIDE TO APPROXIMATE SOIL PERMEABILITIES

SOIL TYPE	PERMEABILITY (m/sec) x 10^{-6}		
	PERMEABILITY CLASS	RANGE	AVERAGE
Rock, Clean Gravel	Unacceptably High	>800	
Medium to Coarse Sand	Acceptable	20 - 800	
Fine Sandy Gravel	Acceptable	20 - 80	50
Silty Sand	Acceptable	8 - 20	15
Sandy Silt	Acceptable	3 - 8	5
Clayey Silt	Unacceptably Low	0.8 - 3	1.5
Silty Clay	Unacceptably Low	0.2 - 0.8	0.5
Clay	Unacceptably Low	<0.8	

NOTE:

- Because of the wide range in permeabilities for sand, it is not appropriate to use an average permeability. Unless the permeability of the material is measured in situ, the lowest permeability, 20 x 10^{-6} m/sec, should be used for system design/selection.

- Because of the low permeability of silty clays and clays the assumptions made regarding the permeability of the clogging mat for more permeable soils may not apply for these soils with low permeability. This combined with the effects of natural precipitation may result in lower effective permeabilities down slope of systems in these soils. Considering these points it is usually not appropriate to design area, trench or C1 type systems for these soils even if the theoretical calculated size can be fit on the lot.

- These soil types are based on texture, the relative content of rock, sand, silt, and clay. It is extremely difficult to accurately determine the long term acceptance rate of soil particularly when basing it only on soil texture. Other factors such as soil density, particle gradation, and soil structure combine to give different permeabilities to soils with similar textures. Unless the permeability is established by in- situ measurement, or the designer has extensive

experience in soil assessment, it would be advisable to use the lowest permeability in the range given for each soil type.

2.5.3 Soil Properties

Some soil properties that are useful in assessing soil suitability include: texture, structure, colour, density, and depth.

2.5.3.a Texture

Soil texture is the relative amount of gravel, sand, silt and clay content. Some soil classes and ways of identifying them are given in **Table 2.2.** When water passes through soil, it goes through the voids between soil particles and not the solid particles themselves. In most cases this means that the larger the voids or pore spaces, and the more pore spaces, the faster the water will pass through the soil. For example, if a sand is compared to a clay it is apparent that the sand has many large voids between relatively large particles whereas the voids between the small clay particles are so small that little, if any, water can pass through. A sand has a high permeability, a clay a very low permeability.

2.5.3.b Structure

In some soils, individual particles tend to group together into blocks or units called peds. If these peds have a characteristic shape, the soil is said to have structure. The space between these peds and how they are aligned can influence the ability of water to move within the soil and may affect a permeability test, giving a false impression of higher permeability. Soils with a platy structure can have a much lower permeability than would be indicated only on the basis of soil texture. For the purpose of these Guidelines, the only further mention of structure will be in Section 6, concerning construction damage. However the qualified person must be aware of the influence that structures may have on soil permeability when conducting the site assessment.

2.5.3.c Colour

Soil colour is a property that is useful in soil assessment. Colour and colour patterns provide clues towards estimating the ability of a soil to absorb water. There are complex colour charts for soil colour determination, which are beyond the scope of these Guidelines. Much of our soil colour is due to the presence of iron. When there is no air in the soil, iron exists in a state that is greyish. When air is abundant in the soil, the soil is well drained, iron is in a state which is yellowish or reddish. If over a long period of time a soil has been alternately wet and dry, it may show defined spots or blotches of different colour, possibly with a grey or dark predominant colour, this is known as mottling. This would indicate that at times (usually spring and fall) this soil is saturated, i.e., poorly drained. On the other hand a well drained soil would be a relatively bright colour (often reddish yellow) and be free of mottling to at least 1.2 metres in depth.

2.5.3.d Density

Soil density or degree of compaction can influence the ability of soils to accept water. Two soils with similar textures can have different permeabilities if their densities are different. The denser a soil becomes, the smaller the pore spaces and the slower the rate of water movement. The natural soil conditions in Nova Scotia are mainly the result of the last glacial age. In many areas the soil is comprised of glacial till, an assortment of material ranging from rocks to clay, that was deposited beneath the ice and subject to great compactive forces. Other areas have soils consisting of sediments deposited by melt water streams that tend to be less compact. Although the top few feet of till tend to have been loosened by weathering and root action, it is common to find increasing compaction with depth and extremely dense and impervious till below a couple of feet.

Soil can also be compacted by actions such as running heavy machinery over it. For a further discussion of man-made compaction, refer to Section 6.

2.5.3.e Depth

Key information in the selection or design of a soil disposal system is the depth of permeable soil, and the depth to a seasonally high water table, bedrock or too permeable soil.

2.5.4 Effective soil depth

Soil effective depth, is the depth of unsaturated permeable soil beneath the surface layer of sod or other organic soil, minus 150 mm, as illustrated by **Figure 2.A** . Soil effective depth is the depth of unsaturated permeable soil that will be allowed to be saturated when the disposal field is loaded at the average rate and effluent is flowing laterally away from the field. The determination of effective soil depth is necessary for C1 systems only. However the effective soil depth has already been allowed for in the selection tables so you will not have to calculate it into your assessment.

TABLE 2.2

TEXTURAL PROPERTIES OF MINERAL SOILS FEELING AND APPEARANCE

Soil Class	Dry Soil	Moist Soil
Rock, Clean gravel	Granular material with few fines. Low percentage of particles less than 2.0 mm	Granular material with few fines. Does not ribbon or form a cast. Low percentage of particles less than 2.0 mm
Medium to Coarse Sand	Sand size (0.2 to 2.0 mm) particles dominate. Aggregates easily crushed when rubbed, feels gritty.	Sand size particles (0.2 to 2 mm) dominate. Squeezed in hand the medium sand will form a weak cast, the coarse sand will not form a cast. Does not form a ribbon.
Fine Sandy Gravel	Loose stones and single grains which feel gritty. Squeezed in the hand, the soil mass falls apart when the pressure is released.	Squeezed in the hand, it forms a cast which crumbles when touched. Does not form a ribbon between thumb and forefinger.
Silty Sand	Aggregates easily crushed; very faint velvety feeling initially but with continued rubbing the gritty feeling of sand soon dominates.	Forms a cast which bears careful handling without breaking. Does not form a ribbon between the thumb and forefinger.
Sandy Silt	Aggregates are crushed under moderate pressure; clods can be quite firm. When pulverized, soil has velvety feel with continued rubbing. Casts bear careful handling.	Cast can be handled quite freely without breaking. Very slight tendency to ribbon between the thumb and forefinger. Rubbed surfaces is rough.
Clayey Silt	Aggregates are firm but may be crushed under moderate pressure. Clods are firm to hard. Smooth, flour-like feel dominates when soil is pulverized.	Cast can be freely handled without breaking. Slight tendency to ribbon between thumb and forefinger. Rubbed surface has a broken or rippled appearance.
Silty Clay	Very firm aggregates and hard clods that strongly resist crushing by hand. When pulverized, the soil takes on a somewhat gritty feeling due to the harshness of the very small aggregates which persists.	Cast can bear much handling without breaking. Pinched between the thumb and forefinger, it forms a ribbon whose surface tends to feel slightly gritty when dampened and rubbed. Soil is plastic, sticky and puddles easily.
Clay	Aggregates are hard; clods are extremely hard and strongly resist crushing by hand. When pulverized, it has a grit-like texture due to the harshness of numerous very small aggregates which persist.	Casts can bear considerable handling without breaking. Forms a flexible ribbon between thumb and forefinger and retains its plasticity when elongated. Rubbed surface has a very smooth, satin feeling. Sticky when wet and easily puddled.

2.6 DETERMINATION OF SYSTEM USAGE

A sub-divider, or applicant to construct or install a system, is required to specify the extent, volume, and type of usage to which the system will be subjected.

This information will be used by a qualified person or the Department to select or design an on-site system. The size of the system may dictate the lot size at subdivision stage, which would be in addition to the minimum lot size requirements set out in Schedule "A" of the *On-site Sewage Regulations*, shown in **Table 2.4**.

For single-unit dwellings, the minimum information required is the number of bedrooms, the expected maximum occupancy of the dwelling, and whether allowance should be made for high water use fixtures.

The minimum flow on which planning, selection or design of a residential on-site system can be based is 1000 L/day. The recommended flows to be used for system design are shown in **Table 2.3** below.

TABLE 2.3

DAILY FLOWS

Dwelling Type	Average Daily Flow (L/day)
3 bedroom home	1000
3 bedroom home with high water use fixtures	1200
4 bedroom home	1350
4 bedroom home with high water use fixtures	1500

These are average flows. It should be recognized that if they are exceeded for more than short periods, the results may be a malfunction of the on-site disposal field.

For system selection as determined by a level 2 Qualified Person (Section 4), an average daily flow of 1000L/day is to be used for a single 3 bedroom home. For a 3 bedroom home with high water use fixtures, or for any 4 bedroom home, an average daily flow of 1500 L/day is to be used.

A garbage grinder will increase the amount of solids to be removed and stored by a septic tank. Where a garbage grinder may be installed, the volume of the septic tank should be increased by 20%.

Estimated flows and loads or systems serving multi-unit residential or non-residential units will depend on additional information to be provided by the applicant and assessed by the designer (QP 1).

2.7 MINIMUM LOT AREA AND WIDTH REQUIREMENTS

A lot proposed for subdivision and is intended to utilize an on-site sewage disposal system, the minimum lot areas and widths in **Table 2.4** apply. For systems with greater than 1500 L per day flow, larger lot areas and lot widths may be required.

The lot width, for purposes of **Table 2.4**, is the minimum dimension of the lot measured at the centre of the area where the disposal field is or will be located, as illustrated by **Figure 2.B** .

The minimum area and width of the lot will depend on:

- the depth of permeable soil
- the maximum expected daily flow rate
- whether the lot is a waterfront lot as defined by the Regulations
- whether an inspector considers that an adverse effect may be created

TABLE 2.4

MINIMUM LOT SIZE REQUIREMENTS FOR DEVELOPMENT UTILIZING ON-SITE SEWAGE DISPOSAL SYSTEMS(1)

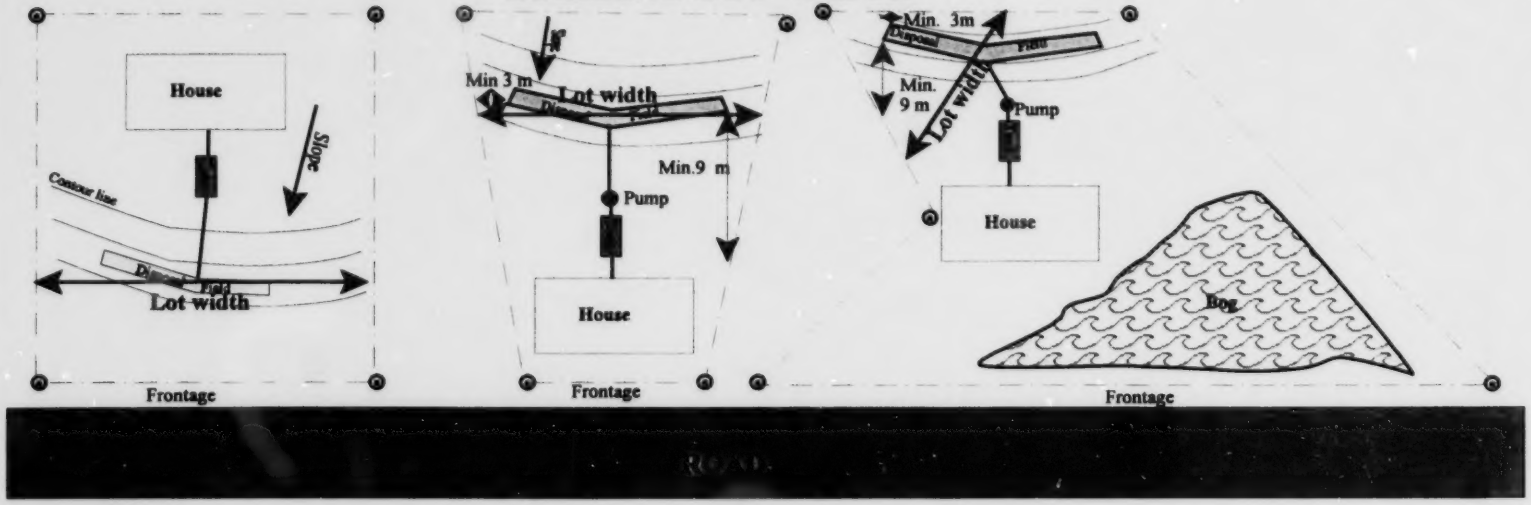
Category	Depth of Permeable soil (mm)	Minimum Lot area (m^2)	Minimum Lot Width (m)
1	Greater than 900	2700	37
1	600 to 900	3150	37
1	Greater than 600 on a waterfront lot(2)	3716	45
2	300 to 600	4500	53
3	150 to 300	6800	60
4	Less than 150	9000	76

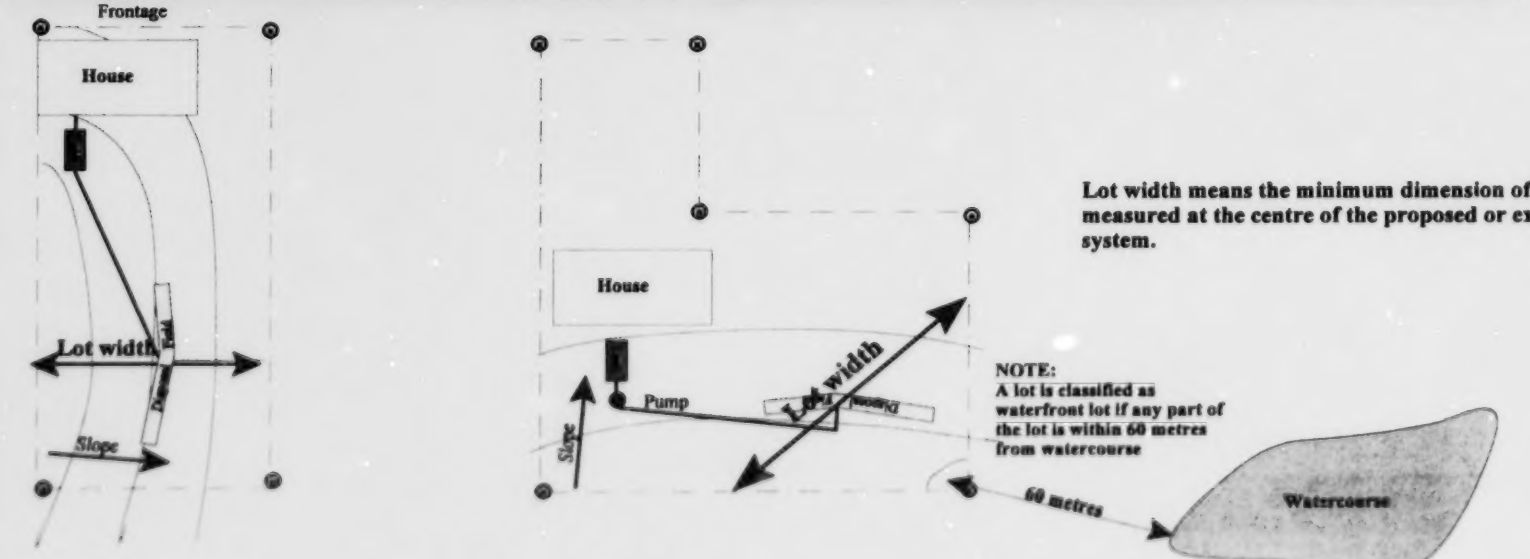
(1) For systems with a daily flow greater than 1500 L/day, larger lot areas and widths may be required.

(2) A waterfront lot is a lot where any portion of a system may be within 60 m of a lake, river, stream, or ocean.

FIGURE 2.B

BUILDING LOT WIDTH





Lot width means the minimum dimension of the lot measured at the centre of the proposed or existing system.

NOTE:
A lot is classified as waterfront lot if any part of the lot is within 60 metres from watercourse

An adverse effect is defined in the Act as an effect that impairs or damages the environment, including an adverse effect respecting the health of humans or the reasonable enjoyment of life or property, and according to Section 22(3) of the *On-Site Sewage Disposal Regulations* includes:

- contaminating a water supply or water used for human consumption
- contaminating a watercourse or wetland
- causing injury or harm to human health.

2.8 SEPARATION DISTANCES

2.8.1 Horizontal Separation

Horizontal separation distances that must be taken into account at the subdivision or system approval stage are listed in **Tables 2.5 (A) and (B)** . These distances relate to separation of the system from features on the lot or adjacent properties.

2.8.2 Vertical Separation

To avoid contamination of groundwater, the bottom of a disposal trench must be separated from groundwater , rock, or other limiting conditions such as unacceptably high permeable soil. It is assumed that cracks or other openings in any rock, or a coarse material like gravel, will allow effluent to pass through it untreated and contaminate groundwater. In this situation system selection or design is based on vertical movement of the effluent and protection of groundwater quality.

Unacceptably low, permeable soil, if it lies above a seasonally high water table or rock, will prevent the downward movement of effluent, except at extremely slow rates, and will protect groundwater from contamination. In this situation, effluent leaving a system will move mainly in a horizontal direction, and system selection or design is based on assuring that the effluent eventually reaches the groundwater, and that any effluent that appears at or near the ground surface is fully treated.

A perched water table may occur above a layer of unacceptably low, permeable soil, and if contaminated may be a threat to shallow wells or water bodies.

The Regulations require that the bottom of a disposal trench be separated by at least 1 m from groundwater, bedrock, or unacceptably high permeable soil. It is not considered necessary to provide the 1m separation where unacceptably low permeable soils occur, unless a perched water table exists, which may pose a risk to wells or surface waters.

The 1 m separation may be provided by natural soil or by imported sand fill used in systems described in Section 4, but may not include soils that have unacceptably high permeability.

TABLE 2.5 (A)
MINIMUM HORIZONTAL CLEARANCE DISTANCES[1]
REQUIRED IN *ON-SITE SEWAGE DISPOSAL SYSTEM REGULATIONS*

FROM	TO	DISTANCE (Metres)
System including septic tank and disposal field[6], holding tank or privy	Any lot boundary	3
	Downslope lot boundary	9
	Drilled well with at least 6.1 m casing[2]	15.2
	Dug well[2,3] or any other water supply	30.5
	Watercourse[4] or wetland[5]	30.5
	Downslope ditch or drain that flows intermittently	15
	Municipal or private water distribution system	6
Septic tank, vault privy or holding tank	Foundation drainage system	1.5
Disposal field[6] or pit privy	Foundation drainage system	6

TABLE 2.5 (B)
MINIMUM HORIZONTAL CLEARANCE DISTANCES[1]
THAT SHOULD BE MAINTAINED WHERE POSSIBLE

FROM	TO	DISTANCE (Metres)
Disposal Field [6]	Downslope boundary Category 2 Category 3 Category 4	 15 25 30
	Downslope sudden increase in slope Category 1 Category 2 Category 3 Category 4	 5 10 15 20
	Man made pond	15
	Wells immediately down slope	100[7]
	Downslope Foundation	20

1. An inspector may require greater distances if adverse effects may be created, and shall provide reasons in writing.

2. See Table 2.5 (B) and note 7.

3. A dug well includes a drilled will with less than 6.1 m. of casing

4. Watercourse means the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein, whether it contains water or not.

5. Wetland means lands commonly referred to as marshes, swamps, fens, bogs, and shallow water areas that are saturated with water long enough to promote wetland or aquatic processes and marine water bodies, which are indicted by poorly drained soil, vegetation, and various kinds of biological activity that are adapted to a wet environment.

6. Separation from the disposal field should be measured from the nearest edge of the trench

7. Whenever possible disposal systems should not be immediately up slope of wells. When planning proposed subdivision layouts it is important to consider relative location of wells and disposal system to avoid problems as lot become developed.

SECTION 3

3. SYSTEM COMPONENTS

3.1 SEPTIC TANKS, HOLDING TANKS AND PUMP OR SIPHON CHAMBERS

The following requirements apply to any tank that is selected or designed for use as a septic tank, holding tank, pump and/or siphon chambers:

1. The tank must be designed to carry a minimum of 1200 mm of earth cover.
2. Septic and holding tanks must conform to Standard CAN/CSA-B66-M90. Metal tanks are not permitted for use as a septic tank, pump or siphon chamber; acceptable materials are reinforced concrete, fibreglass, or polyethylene. Holding tanks, if located above ground, must be non-corrodible. For under ground tanks, metal is not permitted.
3. Where a tank is installed in an area where high groundwater levels may occur ,the proposal shall include precautions to prevent flotation of the tank which includes fitting of the tank with hold-down devices.
4. All tanks must be watertight.
5. Where a riser is required, it shall be
   - watertight
   - firmly attached to the tank with a permanent watertight seal
   - designed to resist frost action.
6. The cover of a tank or a riser shall be
   - watertight
   - secured to prevent unauthorized access and injury.
7. The manufacturer of a prefabricated tank shall provide to the installer instructions for assembly and installation of the tank. The instructions shall have been submitted for review by the Department, to assure that they address the requirements of these Guidelines.
8. A sectional pre-fabricated tank may be assembled on site, provided that the manufacturer's instructions are followed to produce a watertight tank.
9. Where a tank is manufactured from concrete the bung hole must be permanently closed in a watertight manner by the manufacturer.
10. A tank may be constructed on-site if it conforms to applicable requirements of this section and has been designed by a Level 1 Qualified Person.
11. The tank must be tested on site after assembly, for water tightness.**(Figure 3.A)**

3.1.1 Septic Tanks

Any septic tank is required to meet the following specifications: **(Figure 3A)**

1. With the exception of metal tanks, all tanks must conform to the latest edition of Standard CAN/CSA-B66-M90, published by the Canadian Standards Association.
2. It must include a watertight access for purposes of maintenance, inspection, and pump-out.
3. Septic tanks for dwellings must have a capacity not less than that stated in **Table 3.1.** For larger systems the minimum capacity should be:
   - **For average daily flows up to 9000 l/day:** $V_{tank(1)} = 2Q$
     Where: Q - average daily flow in litres
     V_{tank} - tank volume in litres
   - **For average daily flows 9000 l/day or more:** $V_{tank(2)} = 9000 + Q$
     Where: Q - average daily flow in litres
     V_{tank} - tank volume in litres

The minimum required septic tank size is 2800 L. Septic tank sizes larger than the required minimum may reduce problems and extend the life of an on-site system.

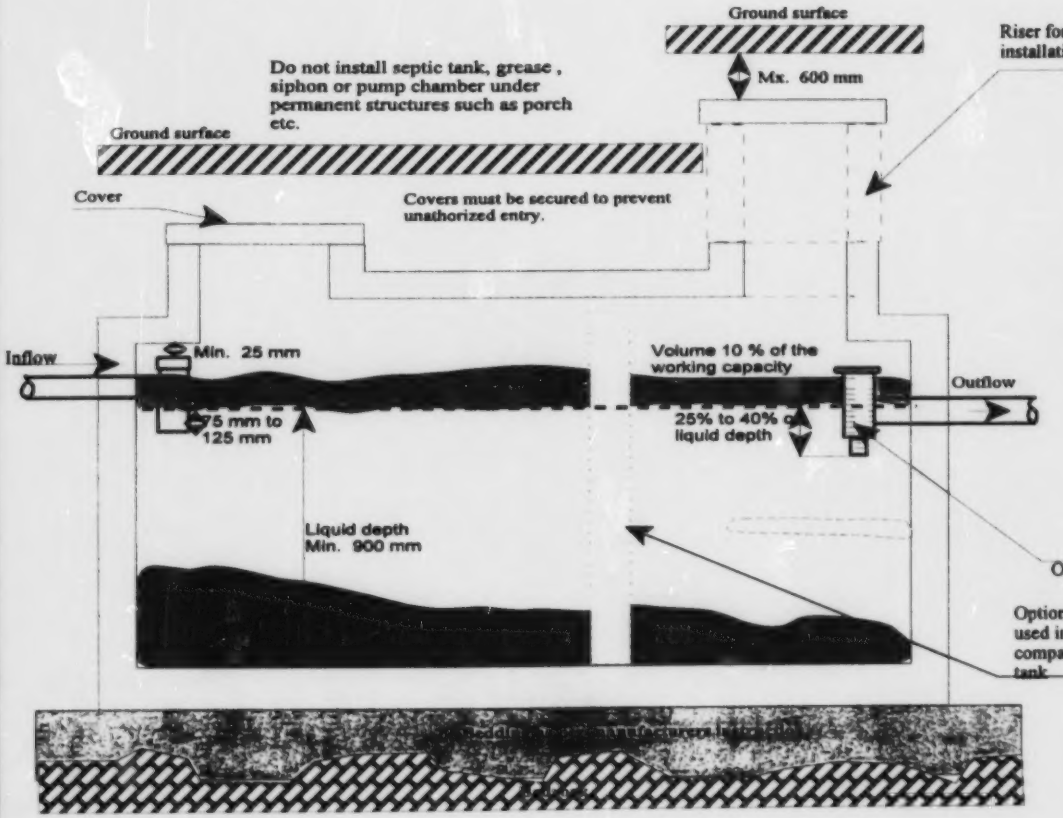
TABLE 3.1
MINIMUM CAPACITY OF SEPTIC TANKS FOR DWELLINGS

Number of Bedrooms	Minimum Liquid Capacity (litres)[1]
Up to3	2800
4	3300
5	4500

4. These values must be increased by 20 percent where a garbage grinder is used.
5. Access to a tank may be provided by a single opening at the center of the tank, but two openings—over the inlet and outlet—are recommended for easier service. The minimum dimension of an opening is 460 mm.
6. If the top of the tank is more than 600 mm below finished grade a riser, with a minimum dimension of 460 mm, must be provided for over the main access opening/riser. A riser must extend to within 200 mm of finished grade.
7. The top of a septic tank must be at least 150 mm and not more than 1500 mm below finished grade or as specified by the manufacturers instructions.
8. Where a siphon chamber is included in the system, it may be an integral part of the septic tank, or be a separate structure.
9. The manufacturer's instructions shall describe how inlet and outlet connections to the tank are to be made in a watertight and structurally secure manner.
10. If a sewage lift pump discharges to a septic tank
    - The volume of the tank must be at least 4500 L
    - The discharge per cycle must not exceed 115 L
    - The discharge rate must not exceed 45 L/min
    - The discharge line must be fitted with a flow control valve.
    - A two compartment tank is recommended.
    - Two single tanks in series can be used as a substitute for a two compartment tank.
11. Except as indicated in Section 3.1.1 #10 above, two compartment tanks are not currently required, but they are recommended because they reduce solids carry-over to the disposal field.

FIGURE 3.A

SEPTIC TANK


Ground surface
Riser for deep installations
Mx. 600 mm
Do not install septic tank, grease , siphon or pump chamber under permanent structures such as porch etc.
Ground surface
Cover
Covers must be secured to prevent unathorized entry.
Inflow
Min. 25 mm
Volume 10 % of the working capacity
Outflow
75 mm to 125 mm
25% to 40% of liquid depth
Liquid depth Min. 900 mm
Optional effluent filter
Optional barrier wall used in 2 compartments septic tank

Dimensions shown on this sketch are for illustration only. Design of the tank must follow latest edition of standard CAN/CSA - B66-M90

GENERAL:

1. A septic tank for a single family will generally require pumping every 3 to 5 years, but should be inspected yearly.
2. Septic tank for commercial applications should be inspected every 6 months.
3. Septic tank should be pumped when the sludge accumulate to a level approximately 450mm below the bottom of the outlet fitting, or if the scum level builds to within 75 mm of the bottom of the baffle or tee outlet.
4. Septic tank must be pumped by a registered septic tank cleaner.
5. Tank, pump/siphon chambers, covers and risers must be sealed completely watertight. Surface drainage should be directed away from the tank or chamber.
6. If the invert of the tank or chamber will be installed below groundwater level it shall be secured in place to prevent flotation
7. **DO NOT ENTER SEPTIC TANK, PUMP CHAMBER OR GREASE TRAP!**

TEST FOR TANKS AND PUMP/SIPHON CHAMBERS

All septic tanks and siphon/pump chambers must be tested for water tightness, after installation and before backfill.

1. If tank or chamber is installed below ground water level, first remove any water from the tank . Tank must be left for 30 minutes and checked for any visible leaks . Prior to test tank must be secured in place to prevent flotation.

2. If the tank or chamber is installed above ground water table, tank must be filled with water to its outlet ,left for 30 minutes and checked for any visible leaks

Any leaks must be repaired and test repeated until all leaks are eliminated.

Prior to test confirm with manufacturer that tank will withstand a hydrostatic pressure.

Where a two compartment tank is used:

- the final compartment should be approximately one-third of the total volume
- the interconnecting port should be about 2/3 of the liquid depth from the bottom of the tank.

3.1.2 Holding Tanks

1. A holding tank must conform to the latest edition of Standard CAN/CSA-B66-M90, published by the Canadian standards Association. **(Figure 3.B)**. Also refer to testing specifications in **Figure 3.A**.
2. The capacity of a holding tank for a single unit residential dwelling shall not be less than 4500 L.
3. A holding tank shall be equipped with an audible and visible high level alarm.
4. A holding tank shall be installed so that its locked riser cover is exposed at or above finished grade, and the area around the cover must be graded to divert surface water.
5. A riser for a holding tank shall have a minimum opening dimension of 450 mm.
6. The installation, operation and maintenance of the holding tank shall be in accordance with minimum standards and policies. Refer to **Subsection 4.10** for further details.
7. A **below ground tank** shall be constructed of a non-metallic material.
8. A holding tank may be utilized for **above ground** services provided:
   - the tank is constructed of non-corrodible material
   - secondary containment is supplied (dykes, berms, etc)
   - adequate weatherproofing is provided to prevent freezing in the tank or lines
   - the tank is supplied with adequate hold down and support systems
   - the inlet shall be on the top of the tank and the inlet line shall be self draining
   - drain valves are locked when not in service or security in the form of a fence is provided
   - the tank vent is equipped with an odor control device or is extended sufficiently above grade to eliminate odors at ground level
   - tank to be installed according to existing Department of the Environment policies, regulations and operational bulletins

3.1.3 Pump and Siphon Chambers

The pump or siphon chamber discharge capacity must be sized to distribute effluent over the entire disposal field during each dose. This allows utilization of the entire field and minimizes the possibility of breakout of effluent in a localized area. Periodic dosing also allows the infiltrative surface to drain between doses. These cycles of alterative dosing and resting may maintain higher infiltration rates in the clogging mat and thus extend the life of the system.

FIGURE 3.B

ALARM DEVICE

Bell for audible alarm may be switched off

Light to give a visual alarm remains on after bell is switched off and until tank is emptied

Cover with lock to prevent unauthorized access

Manhole extension minimum 450 mm diameter with watertight connection to tank

Alarm should sound when holding tank is 75% full.

All connections must be made water tight

Conforms to C.A.N/C.S.A standard B66-M90
Capacity -
Manufacturer -
Year Manufactured

Inlet

Alarm float control

Plug all openings

Make a watertight connection

NOTE:
Tank must be made watertight and must be tested for leaks before it is placed in operation.

Fasten both sides of the septic tank to prevent frost uplifting.
If riser is provided it also must be fastened to prevent frost uplifting

Dimensions shown on this drawing are for illustration only. Design of the tank must follow latest edition of standard CAN/CSA - B66-M90

GRAVITY FED HOLDING TANK

The normal dosing frequency should be two times per day for a system that is selected. When a large system is designed, other dosing frequencies may be necessary. The discharge volume must be large enough to flood the entire distribution pipe. Unless the level 1 or 2 qualified person specifically selects the pump to be used, it is the installers responsibility to ensure that the pump has the proper capacity of achieving equal distribution throughout the field.

A typical **pump chamber** is shown in **Figure 3.C** and should conform to Canadian Standards Association specification CAN CSA-B66-M90.

Requirements for a pump chamber include:

1. The capacity of the chamber shall provide a liquid volume equal to the total of:
   - the volume of a single dose
   - the back flow volume after the pump stops
   - a reserve equal to one days design flow
2. The chamber shall be equipped with an audible and visible high level alarm, level controls, and other accessories required to assure its effective and reliable operation.
3. The access to the chamber shall be installed so that its exposed at or above finished grade.
4. The minimum dimension of the opening in a riser for a pump or siphon chamber shall be at least 760 mm.
5. If the chamber is a pre-fabricated concrete tank
   - the elevation of the tank shall be such that any horizontal seam is located above the highest seasonal groundwater table
   - the high water alarm level must be below the level of the horizontal seam.
6. The pump chamber shall be tested to ensure water tightness. **(see Figure 3.A)**

A **siphon chamber** should conform to Canadian Standards Association specification CAN/CSA-B66-M90.**(Figure 3.E and 3.F)**

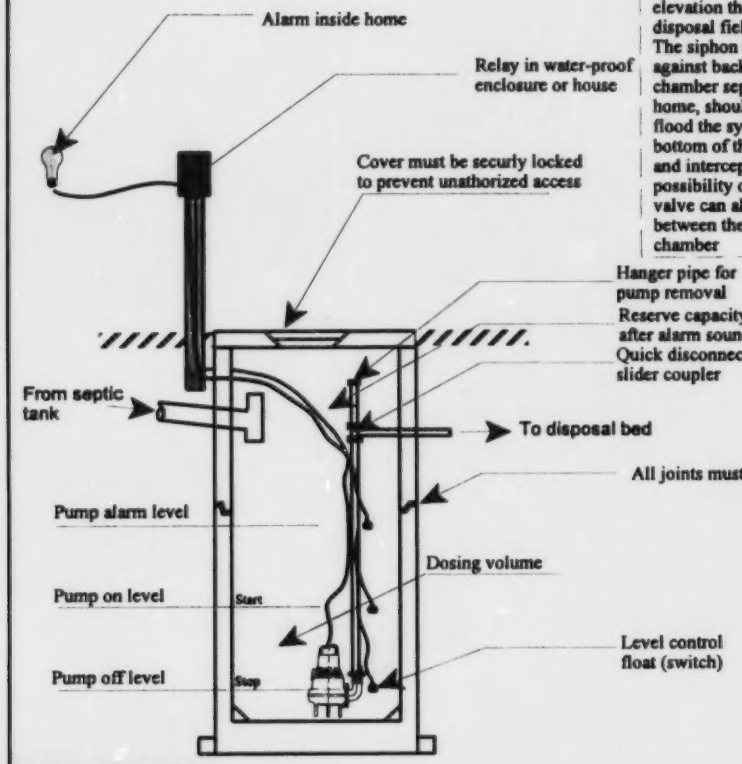
As sewage enters a siphon chamber and the liquid level rises, air within the siphon discharge piping is slowly forced out. When enough air has been forced out, the decrease in pressure is such that the siphon primes and liquid is drawn out of the tank in one event.

Siphons should be designed to deliver the same volume per discharge event as a pump designed for the same disposal field.

The siphon shown in **Figure 3.E** was developed as an alternative to commercial siphons for use in septic tank disposal fields. The siphon is constructed of standard plastic (PVC or ABS) pipe and fittings with solvent welded joints and is suitable for use in a standard pre-cast concrete septic tank as a siphon chamber. The deep draught (the design has been tested at approximately 1.5 m draught) permits the use of a more economical configuration of tank for a given discharge volume.

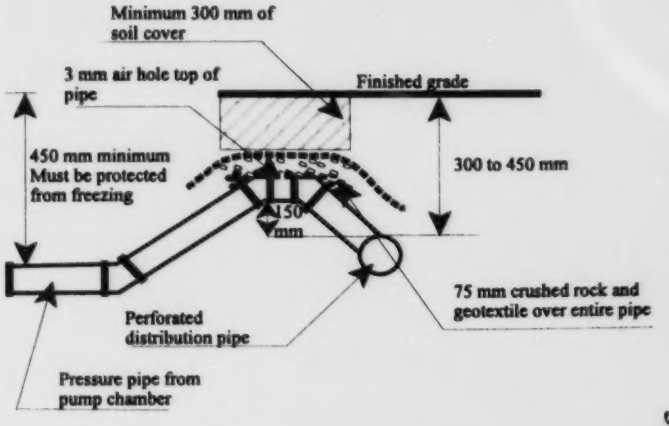
FIGURE 3.C

Pump installation



Siphon Breaker is required on all pump systems with pump chamber at lower elevation than finished grade over disposal field.
The siphon breaker does not protect against backflow into the pump chamber septic tank and possibly the home, should surface or ground water flood the system to a level above the bottom of the "breaker". Lot grading and interceptor ditches will reduce the possibility of this occuring. A check valve can also be installed on the line between the tank and the pump chamber

TYPICAL DETAIL OF FORCEMAIN CONNECTION TO DISPOSAL FIELD "SIPHON BREAKER"


Minimum 300 mm of soil cover
3 mm air hole top of pipe
Finished grade
450 mm minimum Must be protected from freezing
300 to 450 mm
150 mm
75 mm crushed rock and geotextile over entire pipe
Perforated distribution pipe
Pressure pipe from pump chamber

NOTES:

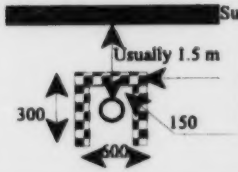
1. The pump chamber must be watertight and surface water must be diverted away from the pump chamber.
2. The pump intake should be kept above the floor at the distance recommended by manufacturer . (Frequently 150 mm or more).
3. The start level control should be set to deliver the required dosage plus an allowance for backflow from the discharge line (if backflow is used for frost protection).
4. The alarm system and the pump must be on separate circuits.
5. All electrical connection are to be made outside the pump chamber and must comply with appropriate electrical code and safety regulations.
6. Pump must be suitable for submerged sewage operation.
7. Level control floats to be non clogging.
8. All pipe joints must be pressure resistant.

FROST PROTECTION:
Following may be employed to protect pressure pipe from freezing:

1. Allowing the effluent to drain back through the pump and into the pump chamber by removing the check valve. This can only be done if design of the pump allows it. Check with manufacturer prior to removing check valve.
2. Installation of check valve at the pump with a bleeder hole just ahead of it. This would prevent effluent from flowing back through the pump and still allow the line to drain.
3. Installation of check valve and pipe protection such as:
   a. Sufficient soil cover over the line. (Usually 1.5 m)
   b. Insulation of the line.
   c. The use of heater tape

Pipe must be installed to prevent any sagging.

PIPE INSULATION



Insulation. Usually 25 mm for each 300mm of soil cover less than 1.5 m.
HI-60 Styrofoam insulation

Volume of 1m pipe section	
Diameter (mm)	Volume(l/m)
38	1.30
44	1.55
50	2.16
64	3.10
70	3.38
75	4.70
89	6.20
95	7.12
100	8.20

The two unusual aspects of the design are important. The siphon break delay tank shown at B on the sectional elevation ensures that the upper limbs of the siphon are completely vented when the siphon breaks. Without the tank and orifice disc, the siphon will break by formation of a vortex at A. On cessation of flow the vortex disappears and the low water level settles above the inlet to the siphon leaving a partial vacuum in the upper siphon at CD. On refilling the chamber the partial vacuum lifts the water over the top bend when the general water level is still below CD and the height of water in leg DE is too high for any bubbles of air to be carried to the discharge. Hence, except at very high flows, the siphon passes the inflow to the discharge without priming and the tank does not empty.

With the delay tank and orifice, as the siphon discharges, some water is retained in the horizontal pipe and the orifice does not clear until the general water level is below B, thus ensuring that air can bubble in until the whole of the upper legs are drained down to the general level.

The second feature is the sloping leg DE which assists in priming the siphon at top water level. Water will begin to flow over the top bend D of the siphon when the head P in the tank is approximately equal to the head in leg FG (Q). Streaming down the low side of the pipe, the flow causes rotary motion in the leg EF, creating a form of horizontal vortex, enabling air from leg DE to the held in suspension and vented to the overflow pipe GH. At the same time the weight of water in leg FG becomes less, because of the entrained air, lowering the pressure at E, which enables a greater flow to pass under head P and the siphon quickly primes.

A prototype siphon of 100 mm diameter pipe primed at a flow of 9 litres per minute. The siphon performs equally well with leg ABC vertical or sloping, as tests showed that the volume of trapped air is not critical. The sloping version should be used in circular tanks but does require to be anchored down to prevent flotation. The siphon has been constructed in pipe sizes from 30 mm to 100 mm diameter.

The design may be adapted to almost any shape and configuration of siphon chamber but certain dimensions are critical. The inlet and overflow may be at the same level but must be at least three inches above the selected top water level. The bottom water level will be from three to five inches above the floor of the chamber. The discharge pipe invert should be at least six inches below the floor level of the chamber. The invert of the top bend of the siphon (marked "CD" on the sectional elevation), which passes through the wall of the chamber, should be set at least six inches below the top water level but may be set lower. The bottom bend (marked "EF") should be set with its soffit exactly the same distance below the invert of the outlet pipe as the invert of the upper bend is below the top water level.

The diameter of the pipework does not appear to be critical but it is suggested that 100 mm diameter would be appropriate for chambers larger than 4500 litre discharge, 75 mm for 900 litres or more and 50 to 65 mm diameter for less than 900 litres. The siphon break delay tank or cross pipe should be of the same diameter as the main pipework, but the length has not been

found to be critical. From 0.5 to 1.0 m has been found satisfactory. The orifice diaphragm placed between the crossed tee's should be securely cemented or sealed in place. It may be cut from flat plastic sheet approximately 46 mm thick and drilled with a 8 mm diameter hole off centre.

Before putting the siphon chamber in service the bottom bend ("EF") should be filled with water via the vertical inspection pipe, otherwise the siphon will trickle continuously without priming. The siphon may then be tested by filling the chamber, reducing the rate of inflow to perhaps two gallons per minute as the water level rises to the expected discharge height. The test should be run at least twice to prove satisfactory operation.

Maintenance requirements are simple. The chamber should be pumped to remove accumulated sediment whenever the septic tank is cleaned. At the same time the delay tank or cross pipe should be flushed out with a garden hose through the vent hole. Should it become evident that the chamber is trickling continuously at a high water level it is probably that the delay tank orifice has become blocked. To lower the water level for clearing this, force the siphon to prime by either increasing the inflow to a high rate or temporarily raise the level by blocking the outflow through the vertical access pipe, and then release it.

Prior to putting the siphon chamber in service, it should be tested at least twice to prove satisfactory operation.

3.2 BUILDING SEWERS AND EFFLUENT LINES

A building sewer for a single unit dwelling, which is defined as the part of the building drainage system carrying sewage that extends from the septic tank or public sewer to a point one metre out from the foundation wall, shall be a 100 mm diameter pipe, conforming to Canadian Standards Association specification CAN/CSA B-182.1. Cleanouts shall be provided at intervals of not more than 30 m, if the length of the building sewer exceeds 60 m.

A building sewer shall be laid at a slope of not less than 2 percent.

An effluent line for a single unit dwelling, which is defined as the pipe that allows effluent to move from the septic tank to the distribution field, shall be a 75 or 100 mm diameter pipe for gravity flow systems and must conform to Canadian Standards Association specification CAN/CSA B-182.1.

An effluent line shall be laid at a slope of not less than 1 percent.

3.3 DISTRIBUTION SYSTEM

3.3.1 Crushed Rock or Gravel

Crushed rock shall be:

- cleaned, washed, and screened,
- free of soft or friable material,
- 98% (by weight) of rock or gravel shall pass a 35 mm screen and
- 98% (by weight) of the rock or gravel shall be retained on a 12 mm screen.

3.3.2 Imported Sand Fill

The following requirements apply to:

- the buffer in a distribution system ie: C2 and raised C2
- the construction of all above ground systems, ie: a C3 and a mound

This material shall:

- if it is a naturally occurring sand or sandy gravel or a washed sand, have a permeability, as placed on site, between 0.00003 and 0.0008 m/sec, as determined by the falling head permeability test **(Appendix B)**
  OR

- be a washed concrete sand that meets the current ASTM-33 or CSA A23.1 specifications.

3.3.3 Filter Sand and Sloping Sand Filter Material

The following requirements apply to:

- The layer of sand (filter sand) installed under the crushed rock in all systems
- The sand used to construct a sloping sand filter

This material shall:

- be a washed concrete sand that meets the current ASTM-33 or CSA A23.1 specifications or
- be a naturally occurring or washed sand having a permeability, as placed on site, between 0.0001 and 0.0008 m/second as determined by the falling head permeability test **(Appendix B)**

3.3.4 Barrier Material (Geotextile)

Barrier material is required in disposal fields to prevent silt in the covering soil from washing or falling into the crushed rock distribution trench.

The barrier material shall:

- be a non-degradable man-made fibre such as polyester or polypropylene
- have an opening size less than 700 microns

- have a permeability greater than 0.001 m/sec.

This specification will normally be met with a light weight (50 g/sq. m or more) non-woven (i.e. felted, needle punched or heat bonded fibre) fabric or proprietary geotextile. The ability to stretch and deform is perhaps of more importance than tensile strength. It should be noted that typical woven geotextiles of ribboned film have insufficient permeability and porosity for adequate aeration of the disposal field and for upward permeation of effluent in high watertable conditions.

3.4 EFFLUENT DISTRIBUTION PIPE

3.4.1 General

Uniform distribution of septic tank effluent over the entire area of the disposal field is critical for the performance and the long life of the system: uneven distribution can result in progressive clogging of the soil interface, or inadequate treatment in very permeable soils.

Periodic dosing of the effluent, with resting periods between doses, also improves the performance of a system.

Effluent distribution can be accomplished by one of two basic methods:

- a gravity distribution system, in which effluent flows from a septic tank to a disposal field because the water level in the tank is higher than the level of the field, or
- a pressure system, in which a pump or siphon is used to create pressure that will force effluent throughout the distribution system

Pipe and pipe joint fittings used in a disposal system must be selected to provide:

- durability
- resistance to crushing due to surface loading
- resistance to differential settlement of soils and system components.

3.4.2 Gravity Distribution Pipes

Gravity pipes in an on-site system shall

1. be watertight, except for pipes in a disposal field
2. have an internal diameter not less than 75 mm
3. have a slope of 50 to 100 mm / 30 m.

Distribution pipes shall conform with Canadian Standards Association standard CSA B182.1.-96 The pipe shall be of PVC or ABS plastic, unless an alternative material with equal or better

properties is approved by the Department of the Environment.

The pipe shall be perforated with 13 mm holes:

- in the invert, at intervals of 3 to 4 m
- at 60 degrees to the invert, at intervals of 1 m or less.

The invert holes are intended to disperse smaller flows; the side holes will disperse larger flows.

3.4.3 Pipe Used In A Pressurized System

A pressurized system is more effective than a gravity system as it provides both uniform distribution and periodic dosing of the disposal field. The disadvantage of a pressurized system is the higher capital cost and the extra maintenance requirements associated with the pump or siphon. Pressurizing using a pump or siphon is required:

- where an end fed field is longer than 30 m or a center fed field is longer than 60m
- where the natural ground slope is not uniform and a gravity system might concentrate effluent at one on more weak spots in the field
- for all C3 and Mound fields
- for any system where the disposal field is at a higher elevation than the septic tank

Where a pump or siphon is required, the solid pipe from the pump or siphon chamber to the disposal field must have a minimum diameter as specified by the pump or siphon manufacturer but shall not be less than 30 mm. For a pump system this line should be equivalent to the Canadian Plumbing Code requirements for water pipe (CSA B137 Series-99) so that it can withstand the pressure exerted by the pump. Lower pressures are generated by a siphon and solid pipe meeting CSA B182.1 with glued joints should be acceptable. All pumped systems should be connected to the disposal field using a "siphon breaker" as shown in **Figure. 3.C.**

For any system selected to serve a single family home other than a Mound or C3 system using a pump or siphon, the perforated pipe in the distribution field can be similar to gravity distribution pipe (Subsection 3.4.2) only all joints must be glued and a 13 mm hole drilled in the top of the pipe 150 mm from the end cap(s).

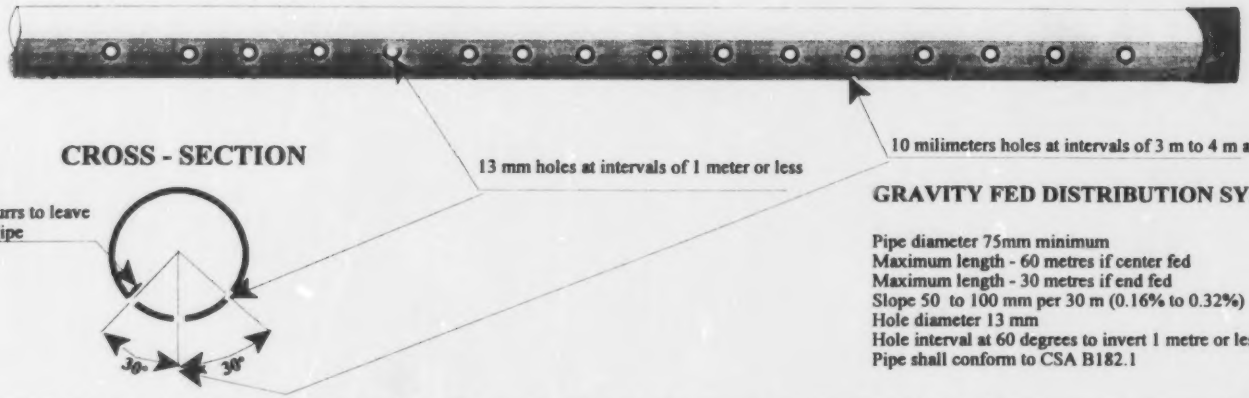
For any system selected to serve a single family home using a Mound or C3 field, solid 75 or 100 mm pipe with holes drilled as outlined in Subsections 4.7.4 and 4.8.4 must be used.

For systems serving more than 1500 l/day (designed by a QP1), the pipe diameter, and hole spacing must be calculated, based on the system hydraulics, in an effort to provide uniform distribution throughout the disposal field. In a designed system the minimum acceptable pipe diameter is 30 mm.

Freezing of the pressure line is a potential problem if it does not empty after every discharge and it is not insulated. **Figure 3.C.** lists several steps that can be taken to protect the pressure line from freezing.

FIGURE 3.D

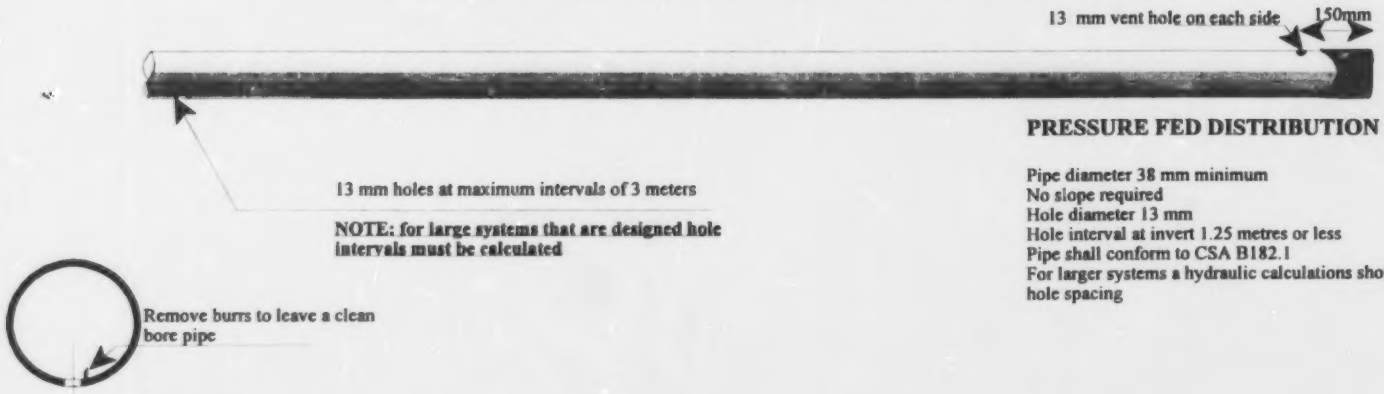
GRAVITY FED DISTRIBUTION PIPE


CROSS - SECTION
Remove all burrs to leave a clean bore pipe
30°
30°
13 mm holes at intervals of 1 meter or less
10 milimeters holes at intervals of 3 m to 4 m at invert

GRAVITY FED DISTRIBUTION SYSTEM

Pipe diameter 75mm minimum
Maximum length - 60 metres if center fed
Maximum length - 30 metres if end fed
Slope 50 to 100 mm per 30 m (0.16% to 0.32%)
Hole diameter 13 mm
Hole interval at 60 degrees to invert 1 metre or less
Pipe shall conform to CSA B182.1

PRESSURE FED DISTRIBUTION PIPE


13 mm vent hole on each side
150mm
13 mm holes at maximum intervals of 3 meters
NOTE: for large systems that are designed hole intervals must be calculated
Remove burrs to leave a clean bore pipe

PRESSURE FED DISTRIBUTION SYSTEM

Pipe diameter 38 mm minimum
No slope required
Hole diameter 13 mm
Hole interval at invert 1.25 metres or less
Pipe shall conform to CSA B182.1
For larger systems a hydraulic calculations should be used to determine best hole spacing

3.5 PUMPS AND SIPHONS

3.5.1 General

A pressure distribution system may be fed by a pump or a siphon. Considerations in selection of these devices include:

- Siphons do not require a power source or involve moving parts
- A siphon can only operate effectively if the available elevation difference between the siphon discharge point and the disposal field distribution pipe is 1 m or more. For a normal siphon installation this is equivalent to 2m in total from the tank outlet to the disposal field.

When a pressure distribution system is required, the siphon or pump should be designed to flood the disposal field twice per day— make sure the entire pipe is completely filled and under pressure.

Where a siphon is required, the siphon must follow a standard design established or adopted by the Department, or shall be designed by a Level I Qualified Person.

3.5.1.a Hydraulic Characteristics

Pumps should be designed to provide a total head equal to the sum of:

- The difference in elevation between the pump and the distribution pipe
- The friction loss in the discharge line between the pump and the far end of the distribution pipe.
- A residual head of 610 mm at the end of the distribution pipe.

The actual design of a pressure distribution system is based upon hydraulic principles and is beyond the scope of these Guidelines. In an attempt to simplify selection and standardize equipment requirements for single family homes, the required dosing capacity for siphons and pumps is as shown in **Table 3.3** .

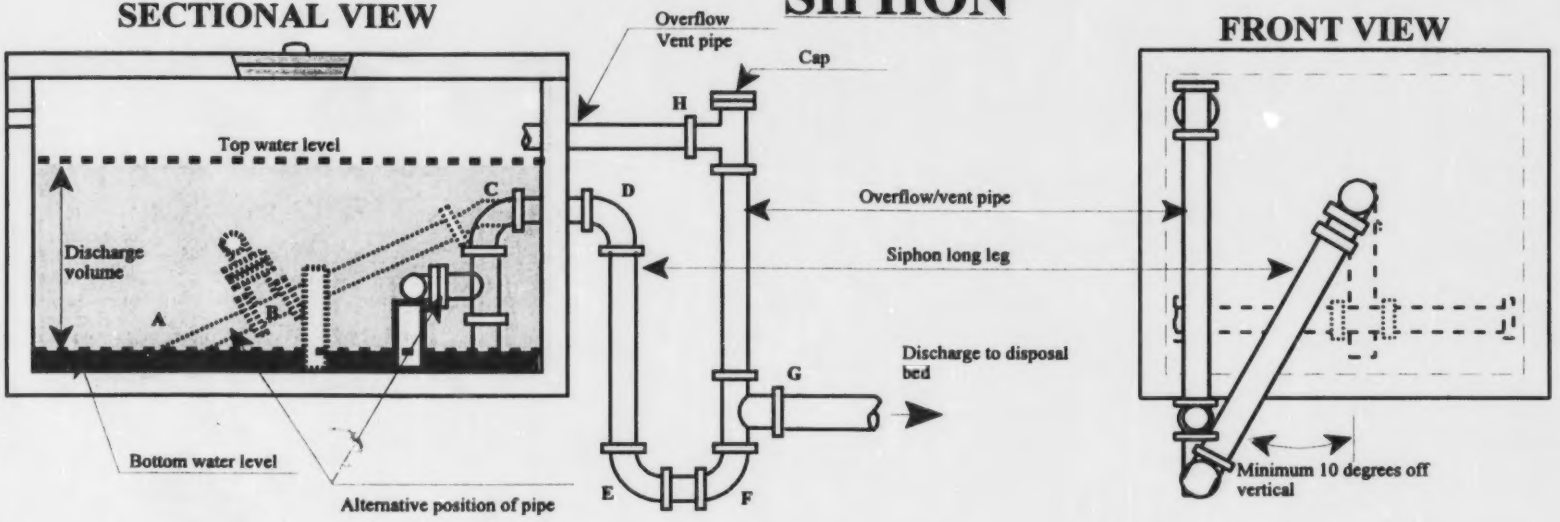
Table 3.3
SIPHONS AND PUMPS DOSING CAPACITY

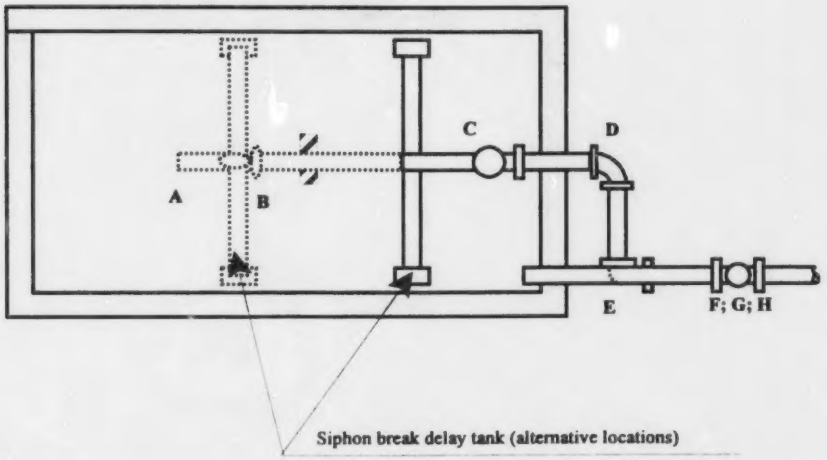
Dwelling Size	Dosing Amount per Discharge Event in Litres
3 bedrooms	500 L
4 bedrooms	750 L

When pumping a considerable distance, the dosing amount may have to be increased to

FIGURE 3.E

SIPHON





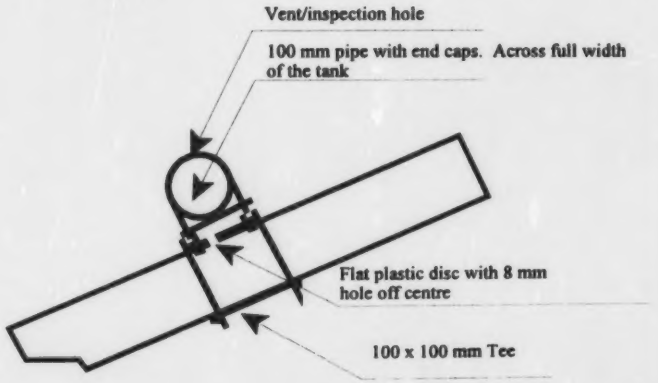
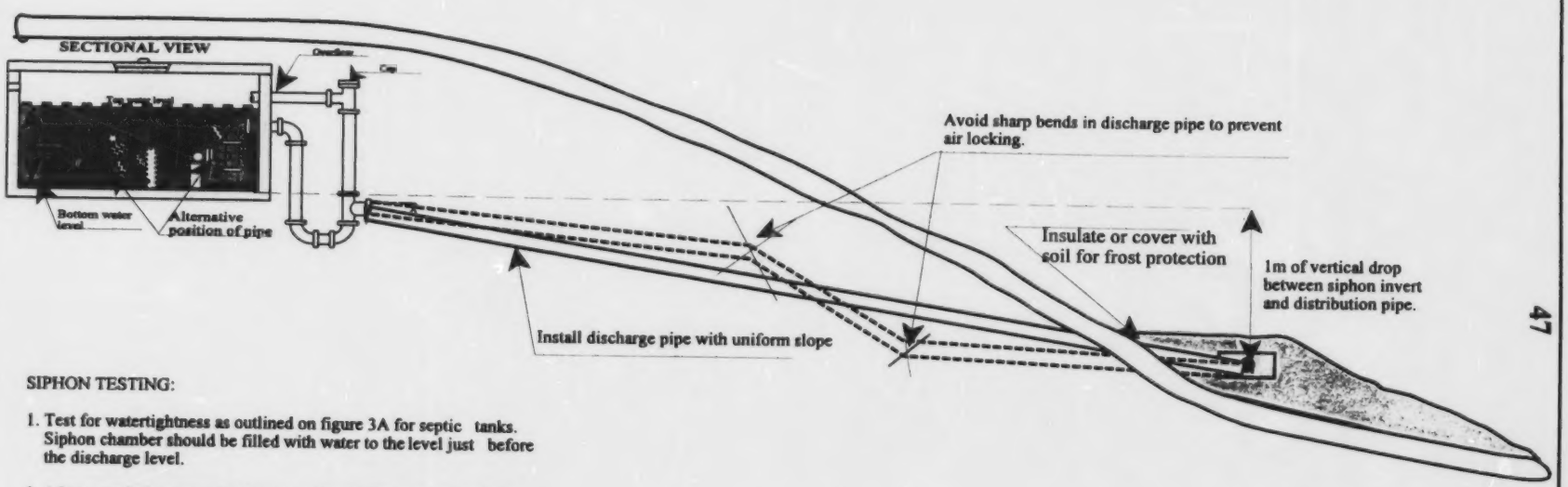

SIPHON BREAK DELAY TANK
Vent/inspection hole
100 mm pipe with end caps. Across full width of the tank
Flat plastic disc with 8 mm hole off centre
100 x 100 mm Tee

FIGURE 3.F

SIPHON INSTALLATION


SECTIONAL VIEW
Bottom water level
Alternative position of pipe
Avoid sharp bends in discharge pipe to prevent air locking.
Insulate or cover with soil for frost protection
1m of vertical drop between siphon invert and distribution pipe.
Install discharge pipe with uniform slope

SIPHON TESTING:

1. Test for watertightness as outlined on figure 3A for septic tanks. Siphon chamber should be filled with water to the level just before the discharge level.

2. After completing water tightness test slowly fill up the chamber to trigger siphon discharge. Repeat this test to see if siphon discharges second time.

compensate for effluent in the pump line returning to the pump chamber after the pump shuts off.

3.5.2 Pumps and Controls

This section specifically addresses pressurized systems for delivery of septic tank effluent to a distribution system in a disposal field. However, the component specifications in this section, and the design principals, apply also to pump systems that may be used to transfer sewage from a dwelling to a septic tank, with some differences. Specifications for pumps and piping that handle raw sewage can differ, and pumping into a septic tank introduces concerns that are discussed in Section 3.1. A siphon breaker should be used where the pipe from the tank enters the distribution pipe. As well, one 13 mm hole should be placed 150mm in from each end of the distribution pipe. **(Figure 3.D)**

3.5.2.a Mechanical-Electrical System

The pump must be suitable for submerged duty in septic tank effluent. The motor housing shall be of stainless steel or epoxy resin coated cast iron, the pump impeller and casing of thermoplastic and the shaft of stainless steel, all designed for non-clogging operation. Level control float switches are to have hermetically sealed contacts. Sealed electrical connectors should be provided in an above-ground weather tight connection box adjacent to the pump chamber, but all associated switch and control gear should be led by duct to the house basement, where positive isolation may be achieved—before any maintenance is carried out—by removal of a plug from a socket.

The complete electrical and mechanical system—including pumps, controls, and switches—must be capable of functioning effectively, reliably, and for many years, in a corrosive environment. These systems should be installed according to the Canadian Plumbing and Electrical Code Requirements.

3.6 INTERCEPTORS

Interceptors are installed to intercept and divert surface water and groundwater upslope of a disposal field. An interceptor may be a trench filled with crushed rock, and containing a perforated pipe, or a swale (shallow trench) at the ground surface. **(Figure 1.B)**.

Situations in which interceptors are required, and their locations relative to the ground surface, are defined in this Section. Construction of interceptors is described in Subsection 6.10.

3.6.1 Interceptor Trench

An interceptor trench may be required or considered in order to address the following situations:

(1) intercept and divert perched groundwater over a layer of impermeable soil
(2) lower a seasonally high groundwater table upslope of a system that is located at lower end of a long slope
(3) intercept and divert surface water.

In situation (1) the base of the trench must be set at least 150 mm into any impermeable layer.

In situation (2) the depth of the trench must be a minimum of 150 mm below the bottom of the distribution field. In some cases this could result in an interceptor depth of up to 2 meters or more.

In situation (3) a trench intended to intercept groundwater may also intercept surface water, or a trench (french drain) may be intended specifically to intercept and divert surface water. In the latter case the trench should be at least 300 mm deep.

The interceptor trench should be 0.3 to 0.6 m in width and be filled with crushed rock that conforms to Section 3.3.1. It may contain a perforated pipe with a slope. The trench must be sloped and sodded where it is practical.

Any interceptor trench must be long enough to divert the intercepted water to a point where it will not enter the disposal system and to where it will freely discharge to the surface, well downslope of the disposal field. It is recommended that the discharge point for the interceptor extend a minimum of 6 metres downslope of the disposal field or buffer. It is recommended that interceptors be located 5 to 10 metres upslope of the distribution field and that they pass no closer than within 5 metres of the end of the disposal field. If these separation distances cannot be achieved, it may be necessary to use impervious fill, such as compacted clay or bentonite, to ensure that surface/ground water does not enter the disposal field nor sewage enter the interceptor.

If the trench is to intercept surface water either the crushed rock should be carried to within 50 mm of the surface--with no topsoil or sod—to allow surface water to enter the trench, or a swale should be included at the surface. The without topsoil option may not be practical if there is a danger that sediment from upslope sources may clog the surface of the crushed rock.

Normally, the interceptor will drain past either or both ends of the disposal pipe, but for very long contour systems, an interceptor drain may be required to cross the disposal system at intervals. Where this crossing occurs the drain shall be constructed of solid pipe and should be laid a minimum of 500 mm below the bottom of the distribution trench (**Figure 1B**).This drain line must be sealed with impermeable fill such as compacted clay or bentonite, for a minimum of 3 metres upslope and 5 metres downslope of the distribution field. Roof water must not be connected to the perforated pipe in an interceptor trench, but may be carried in a solid pipe in the same trench.

3.6.2 Interceptor Swale

A swale is intended to intercept surface water. It may be constructed alone, or at the surface of an interceptor trench.

A swale should be at least 0.3 m deep and 0.6 m wide, and sodded with sloping sides to permit mowing.

The length of any swale must be enough to divert the intercepted water to a point where it will not enter the disposal system and sloped down and beyond the system.

3.7 GREASE CHAMBERS

Grease chambers are not normally necessary on kitchen waste lines from residential development. However, in some commercial/institutional applications such as restaurants, school cafeterias and kitchens at summer camps, grease chambers are required. For the purpose of these Guidelines, a grease chamber is a chamber where grease floats to the surface while the cleaner water underneath is discharged to the septic disposal system. If this grease is not removed prior to the septic tank, large quantities may accumulate in and block the building sewer or the effluent line to the disposal field or the disposal field itself.

The small grease traps found on some commercial/institutional kitchen drains are not considered adequate to protect the disposal system. The liquid volume of the grease chamber must be large enough to permit the water to cool allowing the grease to separate and raise the top of the tank.

The volume of a grease chamber can be calculated from the following equation[16]:

For Restaurants:

$$V_{grease} = D * (HR/2) * GL * ST * LF$$

Where: D - number of seats in dinning area
HR - number of hours open per day
GL - gallons of wastewater per meal (2 or more)
ST - Storage capacity (normally 2)
LF - Loading factor depending on restaurant location

- 1.25 - central locations
- 1.0 - recreation areas
- 0.5 to 0.8 - other locations

For Cafeterias or Institutional kitchens:

$$V_{grease} = M * GL * ST * LF$$

Where: M - Total number of meals served per day
GL - Gallons of wastewater per meal (2 or more)
ST - Storage capacity (normally 2)
LF - Loading factor
- 1.0 with dishwasher
- 0.5 without dishwasher

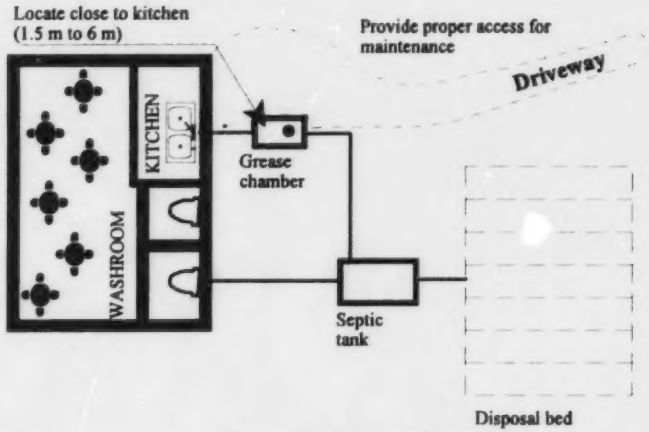
For all but large establishments, a converted 2700 litre septic tank would have adequate capacity to serve as a grease chamber and may be the most economical solution even if it has more than the minimum required capacity. To convert a septic tank to a grease chamber, an elbow can be installed on the outlet and extended to be 150 mm above the tank bottom. **(Figure 3.G)**

To allow for proper maintenance, clean out manholes must be extended to finished grade. The cover must be watertight and secured to prevent unauthorized entry. To minimize problems with grease solidifying in the sewer line the chamber should be located close to the building and no more than 10 m from the fixture being served.

FIGURE 3.G

GREASE CHAMBER

LOCATION

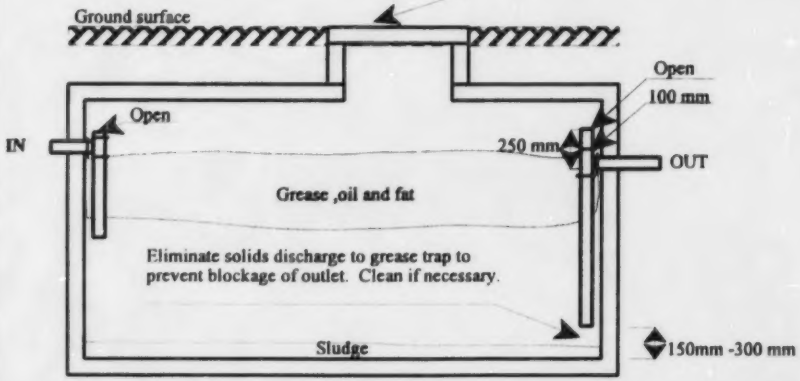


GENERAL::

1. Grease chamber are used to remove excessive amounts of grease oilsand fats from wastewater.
2. They are required in some commercial/institutional applications such as restaurants, school cafeterias, and other commercial kitchens or other applications where large amounts of grease may be released.
3. If grease is not removed it can clog sewer lines ,inlet and outlet structures in septic tank or distribution pipe in disposal bed.
4. Pump out should occur when 50% of tank capacity has been used. Pump out frequencies may be greater than for septic tank depending on chamber capacity and loading.
5. Excessive use of detergents may emulsifiy some of the trapped grease allowing it to escape chamber.

CROSS SECTION

Extend cover to finished grade. The cover must be watertight and secured to prevent unauthorized entry. If cover does not fit tightly a silicon or rubber seal around cover or a layer of clay soil over the cover may be necessary to eliminate odors.
Cover should be designed to withstands expected loads.



GREASE CHAMBER LOCATION AND CONNECTION:

1 .Grease chamber should be located as close as possible to thekitchen(1.5m seperation from building is required)
2. Only kitchen sink(s) and dishwasher(s) should be connected to grease trap.
3. Grease chamber should be located ahead of septic tank.
4. Waste water from garbage grinders should not be discharged to grease chamber as the high solids loading can upset grease tchamber performance and greatly increase the need for frequent pump-out.

Minimum capacity 2700 l

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SECTION 4

4 SELECTION OF DISPOSAL FIELDS

4.1 Introduction

Section 3 described the parts of an on-site system, including a disposal field, and explained that a disposal field includes the following components **(Figures 4.A)**:

- topsoil and sod over the field
- clean local backfill
- synthetic barrier material
- gravity or pressure distribution pipe
- crushed rock
- filter sand
- infiltrative surface
- soil
- imported sand fill

Section 3 also explained the purpose of each of these components.

This section first discusses in more detail the role that disposal fields play in treatment and disposal of effluent from a septic tank. It also deals with selection of a disposal field, including the layout, arrangement, and dimensions of the field.

It then describes, in Sections 4.3 and 4.4, the standard disposal fields that may be selected to suit conditions on most single unit dwelling sites in Nova Scotia, and how a system is selected for a particular site.

Section 5 discusses the design principals on which the design of systems are based. These principles must be applied in development of designs for special conditions or other buildings not covered by Section 4 and 5.

Specification of individual components—such as imported sand fill, pipes, and pumps—are included in Section 3. Construction of systems is covered in Section 6.

A person who selects a system should understand that the dimensions of the systems described in this section are based on assumed site conditions, and do not take into consideration unforeseen variations in hydraulic loads, soil conditions, or ground water levels. To minimize the possibility of system failure, system selection must therefore take into account possible worst-case condition. A system cannot be selected for a lot that consists primarily of foreign fill material or disturbed natural soils.

It should be noted that the selection of systems in these Guidelines applies to systems that will be placed in or directly on naturally occurring soils. If fill has been placed on the site and it is impossible or impractical to remove the fill such that the system will be located in or on the natural soil, a system shall not be selected for the site. However it may be possible for a QP1 to design a system for the site. The design must take into account measures to prevent differential settlement and short circuiting of effluent through unconsolidated fill material.

Removal of natural soil from the site should be avoided as in most cases the top few centimeters of soil and root mat are much more permeable than the subsoils. Where natural soil has been removed from the site, site assessment and system selection or design must be based on the remaining soil conditions.

Not all sites are suitable for selection or design of onsite sewage disposal systems.

4.2 What Disposal Fields Do

On-site systems that are installed in Nova Scotia must recognize the geology and topography that characterize most of this province:

- Soils are generally a mix of sand, silt, and clay; many of these soils are of low permeability (resistant to movement of water), and become less permeable at lower depths.
- Topography is generally hilly.
- Shallow soils with unacceptably low or high permeability.

In most of these soils effluent leaving a distribution system moves downward in the more permeable soil until it reaches a less permeable material or water table. Then the effluent moves laterally, in the direction of the surface or ground water slope.

The effluent will saturate the soil to a depth that depends on the soil type, the slope, and the rate of effluent flow. Where the depth of natural soil below a system is not adequate to carry the effluent flow, the system is raised above ground level and imported sand fill—below and downslope of the distribution trench is used to provide adequate depth to carry the effluent.

It is intended that under most conditions effluent will move downward and remain in the soil under the system. It is recognized, however, that at some times of the year, when the soil beneath the system is saturated, effluent may emerge from the downslope edge of the system. Systems are therefore designed to assure that any effluent that leaves the system is adequately treated. It is also expected that the area immediately downslope of a system will be vegetated (grass or natural vegetation) to allow the treated effluent to travel in the root zone and not on the ground surface.

Most or all of the septic tank effluent will eventually reach the ground water table, directly or by travel in bedrock or very permeable soils. If the effluent is not adequately treated water supplies

may be contaminated, or contaminated ground water may discharge to and contaminate surface waters. It is therefore required that the bottom of the crushed rock in a trench or bed in a disposal field be separated by at least 1 m from the ground water, bedrock, or soil with unacceptably high permeability. This separation may be provided by natural soils, or by imported sand fill.

It is not considered essential to maintain one metre separation where impermeable or low permeability soil occurs, unless a perched water table exists that may pose a risk to wells or surface waters.

The roles of the disposal field are therefore to:

- uniformly distribute the effluent into the soil below the system in order that the hydraulic capacity of the soil is not exceeded
- to provide treatment that assure that effluent that leaves the system and enters the ground water or at the ground surface, will not adversely affect public health or the environment.

4.3 Types of On-site Disposal Fields

The on-site disposal fields discussed in this section are:

- C1 Contour Trench
- C2 Contour Trench
- C3 Contour Trench
- Mound
- Area Bed
- Multiple Trench

The remainder of this section summarizes features of these systems, which are illustrated by **(Figures 4.B, C, D, E, F, G, H, and I)**.

A sloping sand filter may be designed, for a remedial, **by a Level 1 Qualified Person only**. (see Section 5)

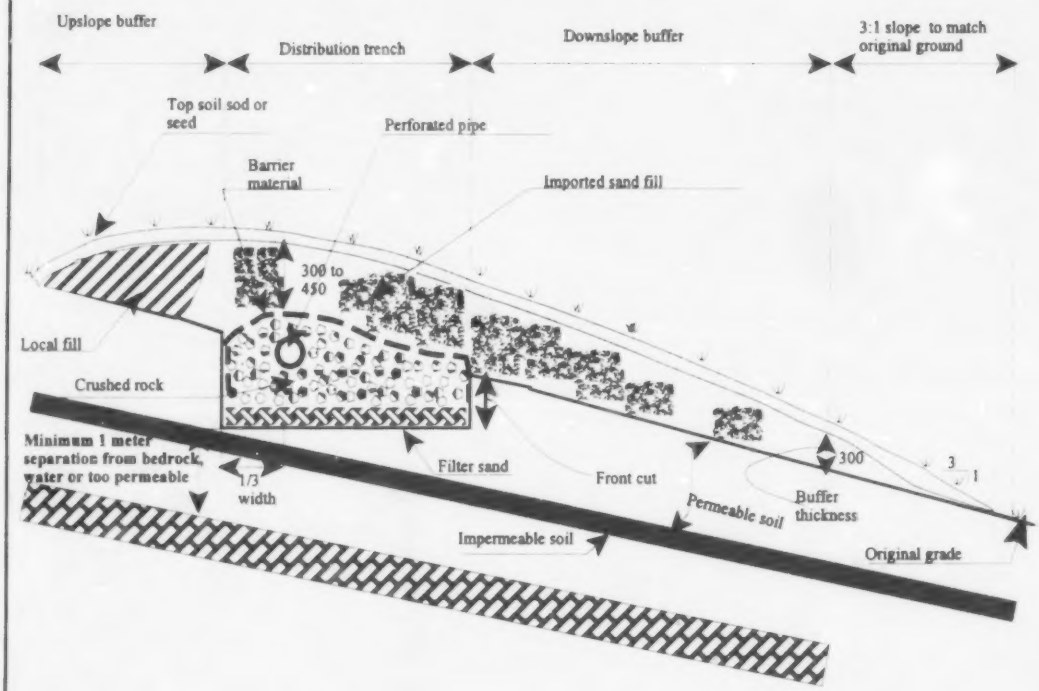
A contour trench disposal field consists of a single disposal trench, which is laid along a contour. (A contour is an imaginary line that joins points of equal elevation on the land surface). The basic differences between C1, C2, C3, and mound systems are shown in **Figures 4.B** through **4.I**.

General requirements relating to selection or design of all contour trench systems are:

- The bottom and downslope lip of the trench must be level.
- The trench must include a 75 mm filter sand layer beneath the crushed rock that

FIGURE 4 A

DISPOSAL FIELD COMPONENTS



surrounds the distribution pipe.

- The sand and crushed rock layers must be laid level without slope and the trench to follow along the contour.
- A gravity distribution pipe is sloped at 50 to 100 mm per 30 m.
- A pressure distribution pipe is level with no slope.
- The maximum depth of a C2, C3, or mound system, from the ground surface to the finished level—including imported sand fill and cover soil—is approximately 1600 mm, to minimize problems due to differential settlement.
- A disposal trench may be continued on either side of a driveway by connecting with unperforated pipe under the traffic area and at least 3 m on either side. Freezing must be prevented by adequate cover or insulation, and the pipe must be selected, installed, and protected, to withstand wheel loads.
- Original soil under a C2, C3 or mound system should not be removed, but it should be ploughed or scarified. Tree stumps should be left and cut off close to the ground surface, where flow along roots is anticipated, roots should be removed.
- Although the effluent from a C2, C3 or mound system is expected to enter the soil below the system, at some seasons of the year effluent may be discharged at the downslope toe of the fill. If this effluent is distributed over the length of the trench it will travel in a thin film in the soil and root mat below the vegetation or grass. It is therefore essential that the area immediately downslope of the system be vegetated (by sod, grass, or natural vegetation), and that bare soil is not exposed in this area.
- A pressure system is required:
  - where an end-fed system is longer than 30 m, or a centre-fed system is longer than 60 m
  - systems greater than 60 m can only be **designed by a level 1 qualified person**
  - where the natural slope is not constant, and where a gravity system may tend to concentrate effluent in one part of the field
  - for any C3 or mound system
  - for any system where the distribution pipe is at a higher elevation than the septic tank
- A disposal system should be located so that the ground level above the disposal field is below the invert of the septic tank outlet (**Figure 1.A)**, except where effluent is pumped from the tank to the disposal system.
- Interceptor trenches or swales must be provided, located and constructed in accordance with Sections 3, 4, and 6.

4.4 Disposal Field Selection

4.4.1 General Considerations

This section deals specifically with selection of on-site disposal systems to serve single unit residential units with maximum wastewater flows that do not exceed 1500 L/day. Systems intended to serve higher flows or other buildings should be **designed by a level 1 qualified person only** in accordance with Section 5.

If it is not possible to select a system based on the requirements of this section, it may be possible to design an appropriate system from first principles based on Section 5. This requires a level I qualified person.

4.4.2 Required Information

Table 4.1 summarizes the nature and source of the information needed before a disposal field can be selected.

TABLE 4.1

INFORMATION NEEDED TO SELECT A DISPOSAL FIELD

Type of Information	Guideline Section
Ground slope at disposal field location	2.4.1
Soil profile – soil types and depths	2.5
Depths of permeable soil	2.5
Highest expected ground water table	2.8
Average daily flow	2.6
Location and dimensions of useable area at disposal field location, based on: - lot area and dimensions - location of house, driveway, etc. - horizontal separation distances	2.7 & 2.8

4.4.3 Preliminary Selection of Disposal Fields

Table 4.2 provides a basis for preliminary selection of disposal fields described in this section. Final selection should be based on the procedures described in the remainder of this section.

TABLE 4.2

DISPOSAL SYSTEM SELECTION OPTIONS

Not all options provided are suitable for each property being assessed, separation distances to water table etc must be taken into consideration.

Permeable Soil Depth (mm)	Slope less than or equal to 3 %	Slope greater than or equal to 3% and less than 5%	Slope 5% to 30%	Slope over 30%
0 to less than 300	Mound	Mound	C3, C2(*r*)	**Not Acceptable For Selection. Design Only By A Level 1 Qualified Person**
300 to less than 600	Mound	C2, Mound,C2(*r*)	C2, C3,C2(*r*)	
600 to less than 750	Mound Area Bed	C2, C2(*r*) Mound	C2, C3,C2(*r*)	
750 to less than1300	Multiple Trench(r) Area Bed(*r*), Mound	C1, C2,C2(*r*), Mound	C1, C2, C3,C2(*r*)	
over 1300	Area Bed, Multiple Trench, Mound	C1, C2, C2(*r*), Mound	C1, C2, C3,C2(*r*)	

Note:

C2(r) - Raised C2 contour trench
C1 - can also be raised from fully trenched to the point where it becomes a C2 trench.
Preference is to be given to the first type of system in the list, then the next, etc. For instance, before selecting a C3 for a property, it should be determined first that a C1 or C2 trench cannot be used.

Each of the above mentioned systems is suitable, however each system increases in cost with the installation of imported sand fill material.

4.4.4 Limiting Slopes

Limiting slopes for selection of disposal fields are indicated in **Table 4.3**.

TABLE 4.3

MINIMUM AND MAXIMUM SLOPES FOR SELECTION OF DISTRIBUTION FIELDS

System Type	Minimum Slope %	Maximum Slope % (1)
Contour C1	3%	30%
Contour C2	3%	30%
Contour C3	5%	30%
Mound	0%	5%
Area or Trench	0%	3%

(1) *If slopes for a contour trench exceeds 30 %,, a system must be designed in accordance with Section 5 to specify appropriate construction methods and assure the stability of imported sand fill.*

4.5 C1 CONTOUR TRENCH

4.5.1 Introduction

Details of a C1 Contour trench are shown in **(Figure 4.B)**.

A C1 trench may be selected:

- where the surface slope at the location of the trench is at least 3 percent
- there is at least 750 mm of unsaturated permeable soil
- where the width of the lot will allow for the length of the selected C1 trench

A C1 trench is fed by a gravity distribution system, except that a pressure system is required where the distribution field is at a higher elevation than the septic tank, or the length from the tee feeding the system to the end of the distribution pipe exceeds 30 m.

An interceptor trench or swale may be necessary, to intercept and divert surface or ground water if a perched water table exists, or if the system is located at the lower end of a long slope.

4.5.2 Depth Limitations for a C1 Contour Trench

Figure 4.B illustrates two possible C1 contour installations dependent upon the depth to an elevation of ground water, rock, soil with unacceptably high permeability or a perched water table.

As illustrated in the raised C1 cross section **(Figure 4.B)**, soil depth can be increased if the trench is raised by not moire than 300 mm. This trench will require an earth cover as illustrated and an interceptor trench and/or swale. The requirement of an interceptor may not be necessary if existing topography or an existing ditch is 15 m upslope and completely removes surface and/or ground water from the contour area.

The C1 selection tables provide the minimum values for effective soil depth "D" to soil with unacceptably high permeability, water table or bedrock.

The effective soil depth is the total depth of natural unsaturated soil with acceptable permeability beneath the surface layer of sod and organic minus 150 mm. These numbers are represented on **Tables 4.4a and 4.4B**.

It is important that the C1 trench excavation not penetrate the soils with unacceptably low permeable or impermeable soils. It should also be noted that the draining of a perched water table may allow for the increase of an effective soil depth.

4.5.3 Layout of a C1 Trench

Figure 4.B illustrated the layouts of fully trenched C1 and raised C1 trenches.

A trench is excavated along the contour to a depth referred to as the "C " cut in **Tables 4.4a and 4.4b**. The trench is then excavated the necessary width while keeping the bottom of the trench perfectly level throughout its length and width. Filter sand is to be deposited in the bottom of the trench to a depth of 75 mm, upon which a minimum of 125 mm of crushed rock will be placed. The amount of crushed rock at the tee will exceed 125 mm because the pipe will sloped toward(s) the end(s) of the system. (Also see Construction Section for more details on layout, page 127)

4.5.4 Selecting a C1 Contour Trench

The length of a C1 trench is determined using **Tables 4.4.a, and 4.4.b** . The table used will depend on the average daily flow leaving the dwelling, the depth of permeable soil, the type of permeable soil, the slope in the location of the system. The amount of room for a contour system on the property, and the total depth of soil above water table, bedrock, or soil of unacceptably high permeability must be taken into consideration in your selection of the table(s).

The length of a C1 trench will range between 25 m and 60 m. If a C1 system cannot be selected through the use of the tables then a C2 system will have to be considered.

A C1 system can be selected as follows:

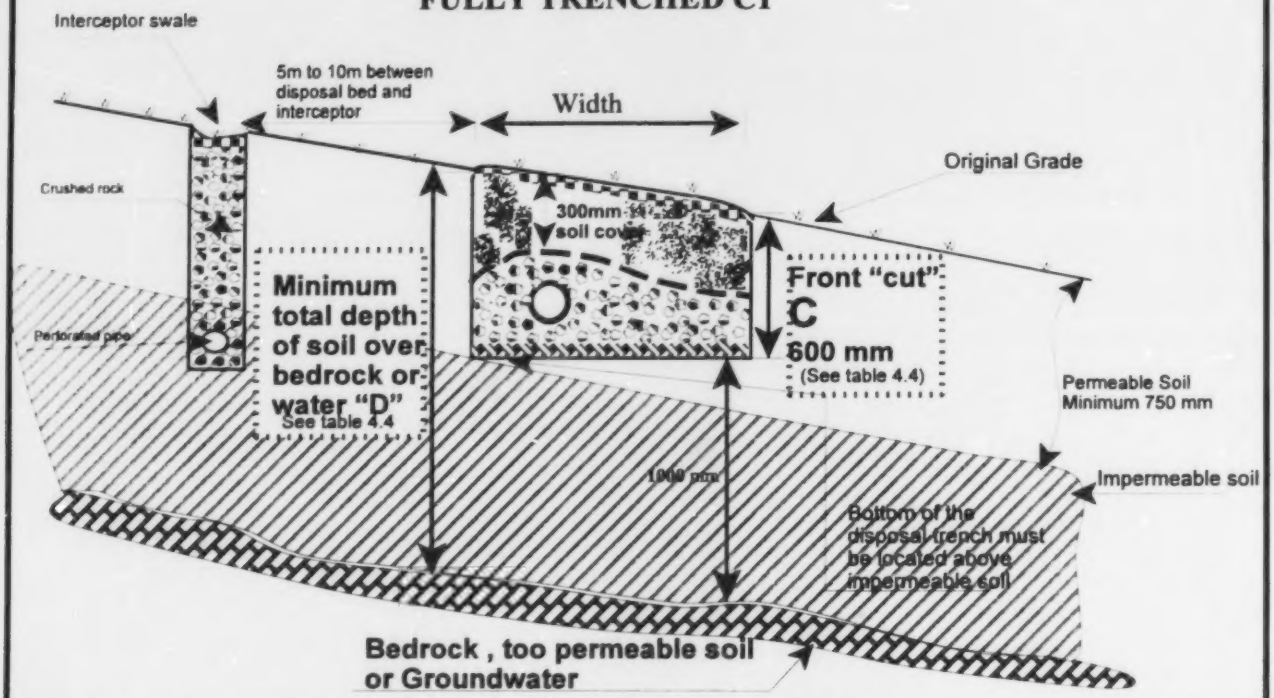
a) **Determine the average daily flow Section 2.6 and Table 2.3** . In terms of system selection either 1000 L/day or 1500 L/day will be used.

b) **Determine the surface slope at the proposed location of the disposal field.** If the slope is less than 3 percent or greater than 30 percent, a C1 cannot be considered for selection.

(c) **Determine the type(s) of permeable soil from Table 2.1.** If more than one type of permeable soil is present (i.e. 800 mm of sandy gravel and 300 mm of silty sand) the type with the lowest permeability is used for the selection tables, 4.4a and 4.4b.

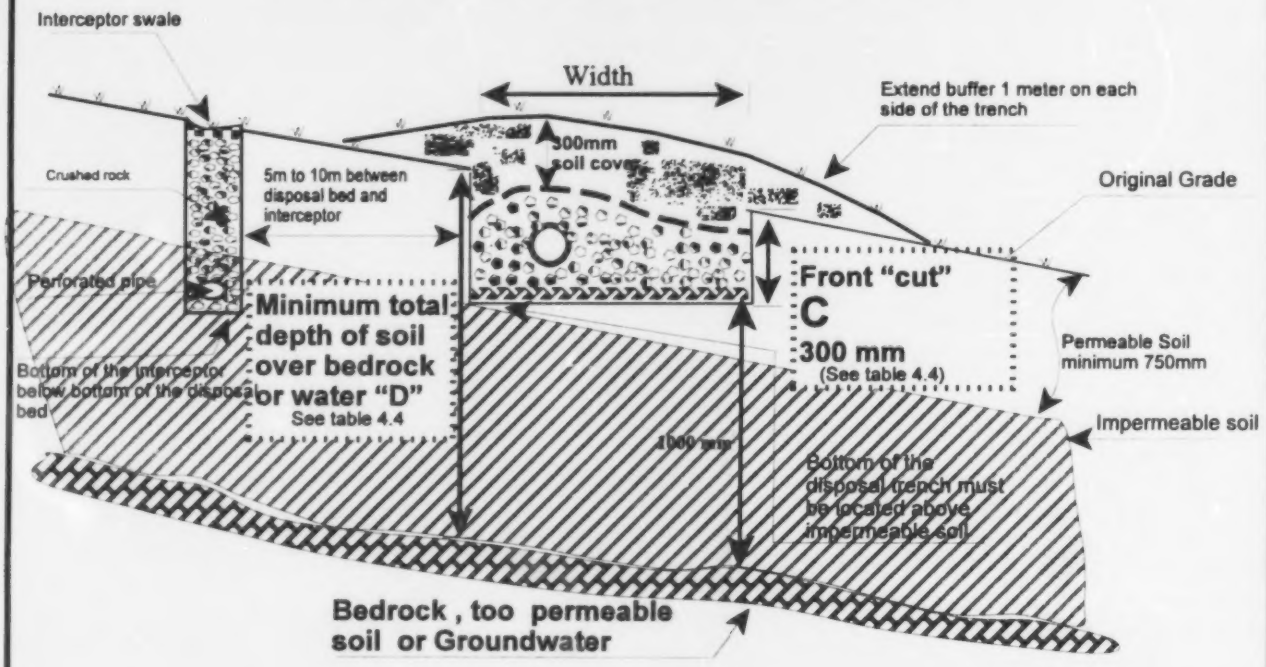
FIGURE 4.B

FULLY TRENCHED C1


Interceptor swale
5m to 10m between disposal bed and interceptor
Width
Original Grade
Crushed rock
300mm soil cover
Minimum total depth of soil over bedrock or water "D"
See table 4.4
Front "cut" C
600 mm
(See table 4.4)
Perforated pipe
Permeable Soil Minimum 750 mm
1000 mm
Impermeable soil
Bottom of the disposal trench must be located above impermeable soil
Bedrock , too permeable soil or Groundwater

RAISED C1

Raised C1 should be used when table 4.4 inicates 0.3m "cut". Front cut **"C"** can be changed from 600mm to 300mm and corresponding required total depth **"D"** can be decreased by 300mm.


Interceptor swale
Width
Extend buffer 1 meter on each side of the trench
300mm soil cover
Crushed rock
5m to 10m between disposal bed and interceptor
Original Grade
Perforated pipe
Minimum total depth of soil over bedrock or water "D"
See table 4.4
Front "cut" C
300 mm
(See table 4.4)
Bottom of the interceptor below bottom of the disposal bed
Permeable Soil minimum 750mm
1000 mm
Impermeable soil
Bottom of the disposal trench must be located above impermeable soil
Bedrock , too permeable soil or Groundwater

d) **Determine the depth(s) of permeable soil.** If more than one type of permeable soil is present (i.e. 800 mm of sandy gravel and 300 mm of silty sand) the total depth of permeable soil (in this case) 1100 mm of silty sand is used for the tables. If the total depth of permeable soil is less than 750 mm a C1 cannot be considered for selection.

e) **Determine the total depth of soil "D"** (soils with acceptable and unacceptable permeability) to water table, bedrock, soil with unacceptably high permeability. If this value is less than 1.3 m, then a C1 cannot be considered for selection. Refer to selection tables for the exact minimum "D" value required.

f) **Refer to the appropriate selection table for C1 selection** based upon the daily **flow** determined in (a). The daily flow used is in the title box at the top of each table.

g) Using the slope determined in (b), the soil type determined in (c), and the depth of permeable soil determined in (d), find the value for "L" (trench length in metres), "D" (minimum required total soil depth), and "C" (depth of cut at the toe of the contour trench). For example, in **Table 4.4a** , a slope of 5% with 900 mm of silty sand gives a required "L" of 31 m, a required "D" of 1.65 m and a required "C" of 0.6 m. If the available contour on the property equals or exceeds "L" *and* the total depth of soil present equals or exceeds "D", then a C1 with the corresponding "L " and "C " can be used. **Figure 4.B** illustrates the situation where impermeable soil or soil with unacceptably low permeably occurs and ground water is not at risk, if the depth of unsaturated permeable soil is less than 1 m. The slope must be at least 3%. The heel of the trench must not penetrate the low permeable or impermeable soil.

h) **Once a minimum length of C1 trench has been determined**, consideration should be given to increasing the length as much as is practical up to a maximum of 60 m. For instance, if the available contour is 30 m, yet the length "L" determined by the table is 25 m, 30 m is recommended for the length.

In cases where there is insufficient depth of total soil available, less than the "D" shown on the tables, the difference can be made up by raising the cut from 0.6 m to 0.3 m and using the same corresponding "L "value you would have used with the 0.6 m cut "C ".

If the cut, "C ", is already shown in the table as 0.3 m and the total soil available is less than what is required, then a C-1 contour cannot be considered for selection.

i) Once it has been determined that a C1 of a particular length can be used by, refer to **the *Disposal Trench Width in Metres*, Table 4.5** to find the appropriate width of trench.

j) The cross section dimensions of the disposal field will be as shown in **Figure 4.B** .

An example of the selection procedure for a C1 is provided in **Appendix E** .

TABLE 4.4 A C1 SYSTEM SELECTION SINGLE FAMILY 3 BEDROOM HOUSE FLOW 1000 l/d

Slope % L= pipe length in meters; C= front cut in meters; D= minimum required total soil depth above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 to 30
Medium to Coarse Sand and Fine Sandy Gravel Permeability: 20E-6 m/s (1.73 m/d)	750 to 899	L=32	D=1.7 L=25 C=0.6						D=1.8 L=25 C=0.6			D=1.5 L=25 C=0.3							D=1.6 L=25 C=0.3									
	900 +	L=26										D=1.8 L=25 C=0.6							D=1.9 L=25 C=0.6									
Silty Sand Permeability: 8E-6 m/s (0.691 m/d)	750 to 899		L=48	L=44	L=40	L=34	L=30	L=27	D=1.5 L=25 C=0.3															D=1.6 L=25 C=0.3			
	900 to 999		L=48	L=39	L=32	L=28																					
	1000 to 1099	L=57	L=43	L=34	L=28				D=1.8 L=25 C=0.6										D=1.9 L=25 C=0.6								
	1100 to 1199	L=51	L=38	L=30				D=1.7 L=25 C=0.6																			
	1200 to 1299	L=46	L=34	L=28																							
	1300 to 1399	L=42	L=31																								
Key:		D= 1.7 C=0.6																									

TABLE 4.4 A C1 SYSTEM SELECTION SINGLE FAMILY 3 BEDROOM HOUSE FLOW 1000 l/d

Slope % L= pipe length in meters; C= front cut in meters; D= minimum required total soil depth above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 to 30
Sandy Silt *Permeability:* 3E-6 m/s (0.259 m/d)	750 to 899									L= 58	L= 54	L= 49	L= 46	L= 43	L= 40	L= 37	L= 36	L= 34	L= 32	L= 31	L= 29	L= 28	D= 1.6 L=25 C=0.3					
	900 to 999							L= 57	L= 51	L= 47	L= 43	L= 40	L= 37	L= 34	L= 32	L= 30	L= 29	L= 27	L= 26									
	1000 to 1099						L= 57	L= 50	L= 45	L= 41	L= 38	L= 35	L= 32	L= 30	L= 28	L= 27												
	1100 to 1199					L= 58	L= 51	L= 45	L= 41	L= 37	L= 34	L= 31	L= 29	L= 27	D=1.8 L=25 C=0.6					D=1.9 L=25 C=0.6								
	1200 to 1299					L= 52	L= 46	L= 41	L= 37	L= 33	L= 31	L= 28	L= 26															
	1300 to 1399				L= 56	L= 48	L= 42	L= 37	L= 34	L= 30	L= 28	L= 26																
Key:		D= 1.7 ; C=0.6							D= 1.8; C=0.6											D=1.5 ; C=0.3								

Note:
1) Length (L) selected from the table is a minimum required length of the slope, soil type and depth. It is recommended that system should be made as long as width of the lot permits (not to exceed 60 meters). If length (L) indicated on this table is not available, consider the selection of another type of system..
2) If total soil depth "D" is less than indicated in this table, then refer to charts for C-3 selection.
3) If more than one type of permeable soil is present in the test pit, use permeable soil with the lowest permeability for selection and total depth of all permeable soils.
4) Width of trench (W) is to be determined by referring to Table 4.5.

When selecting a soil type, the permeability shall not be less than that indicated for that particular soil type.

m/s - meters per second m/d - meters per day 1 meter = 1000 millimeters = 39.4 inches = 3.28 feet

TABLE 4.4 B C1 SYSTEM SELECTION SINGLE FAMILY 4 BEDROOM HOUSE FLOW 1500 l/d

Slope % L= pipe length in meters; C= front cut in meters; D= minimum required total soil depth above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10	11	12	13 to 17	18	19	20 to 22	23 to 27	28	29 to 30
Medium to Coarse Sand and Fine Sandy Gravel Permeability: 20E-6 m/s (1.73 m/d)	750 to 899	L=4 8	L=3 6	L=2 9	D=1.7 L=25 C=0.6				D=1.5 L=25 C=0.3			D=1.6 L=25 C=0.3			D=1.7 L=25 C=0.3	D=1.8 L=25 C=0.3		
	900 to 999	L=3 9	L=2 9						D=1.8 L=25 C=0.6			D=1.9 L=25 C=0.6			D=2.0 L=25 C=0.6	D=2.1 L=25 C=0.6		
	1000 to 1099	L=3 4																
	1100 to 1199	L=3 0																
	1200 to 1299	L=2 8																
	1300 to 1399																	
Silty Sand Permeability: 8E-6 m/s (0.691 m/d)	750 to 899					L=82	L=45	L=40	L=36	L=33	L=25	D=1.6 L=25 C=0.3			D=1.7 L=25 C=0.3	D=1.8 L=25 C=0.3		
	900 to 999	L=38	L=48	L=4 1	L=3 6	L=32	L=29	L=26	D=1.8 L=25 C=0.6			D=1.9 L=25 C=0.6			D=2.0 L=25 C=0.6	D=2.1 L=25 C=0.6		
	1000 to 1099	L=5 1	L=43	L=3 6	L=3 2	L=28												
	1100 to 1199	L=5 7	L=4 6	L=3 8	L=3 3	L=2 9	D=1.7 L=25 C=0.6											
	1200 to 1299	L=5 2	L=4 1	L=3 4	L=3 0	L=2 6												
	1300 to 1399	L=4 7	L=3 8	L=3 1	L=2 7													

Key:

D=1.7 C=0.6

D=1.8 C=0.6

TABLE 4.4 B C1 SYSTEM SELECTION SINGLE FAMILY 4 BEDROOM HOUSE FLOW 1500 l/d

Slope % L= pipe length in meters; C= front cut in meters; D= minimum required total soil depth above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4 to 8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 to 30
Sandy Silt Permeability 3E-6 m/s (0.259 m/d)	750 to 899											L=57	L=54	L=51	L=48	L=46	L=44	L=42	L=40	L=39	L=37	L=36	L=34	L=33
	900 to 999							L=59	L=55	L=51	L=48	L=45	L=43	L=41	L=39	L=37	L=35	L=34	L=32	L=31	L=30	L=29	L=28	L=26
	1000 to 1099						L=57	L=52	L=49	L=45	L=42	L=40	L=38	L=36	L=34	L=32	L=31	L=30	L=28	L=27	L=26	D=1.8 L=25 C=0.3		
	1100 to 1199					L=55	L=51	L=47	L=44	L=41	L=38	L=36	L=34	L=32	L=30	L=29	L=28	L=26	D=2.1 L=25 C=0.6					
	1200 to 1299				L=55	L=50	L=46	L=42	L=39	L=37	L=34	L=32	L=31	L=29	L=28	L=26	D=2.0 L=25 C=0.6							
	1300 to 1399			L=55	L=50	L=46	L=42	L=39	L=36	L=34	L=31	L=30	L=28	L=26	D=2.0 ; C=0.6		D=2.1 C= 0.6		D=1.8 ; C=0.3					
	Key:	D= 1.6 ; C=0.3		D= 1.8 ; C=0.6				D= 1.9 ; C= 0.6																

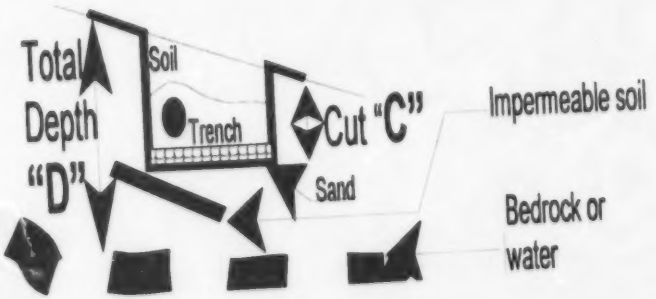
ote: 1) Length (L) selected from the table is a minimum required length of the slope, soil type and depth. It is recommended that system should be made as long as width of the lot permits (not to exceed 60 meters). If length (L) indicated on this table is not available, consider the selection of another type of system.

3) If more than one type of permeable soil is present in the test pit, use permeable soil with the lowest permeability for selection and total depth of all permeable soils.

4) Width of trench (W) is to be determined by referring to Table 4.5.

When selecting a soil type, the permeability shall not be less than that indicated for that particular soil type.

m/s - meters per second **m/d - meters per day** **1 meter = 1000 millimeters = 39.4 inches = 3.28 feet**



4.6 C2 CONTOUR Trench

4.6.1 Introduction

A C2 contour trench may provide an alternative in situations where a C1 trench cannot be used. Two types of C2 systems are used; a standard C2 , which has historically been used, and a raised C2. **Figure 4.C** illustrates the layout.

A C2 trench is similar to a C1 trench in that effluent leaving the trench is expected to first move laterally in the soil below the organic surface layer. In a standard C2 a layer of imported sand fill, above the ground surface, enables saturation of the existing soil to the natural ground surface without fear of breakout. In a raised C2, a portion of the imported sand fill is expected to become saturated along with the natural soil.

Use of C2 systems is limited to locations where the surface slope at the location of the trench is at least 3 percent. If the slope is less than or equal to 3 percent an area bed, or multiple trench, should be considered and the exact selection is dependent on the thickness of the natural permeable soil. For a slope greater than or equal to 3% but less than 5%, a mound can be considered.

A C3 or a mound system may be required where the length of trench required for the system exceeds that available for a C2 trench.

A modified C3 trench, constructed according to **Figure 4.F**, should be used instead of a C2 trench where uneven surfaced lots, boulder fields, or wooded area are encountered.

A C2 trench is fed by a gravity distribution system, except that a pressure system is required where:

- the length from the tee feeding the system, to the end of the distribution pipe, exceeds 30 m
- the natural slope is not constant and a gravity system may tend to concentrate effluent in one part of the system
- the distribution pipe is at a higher elevation than the septic tank.

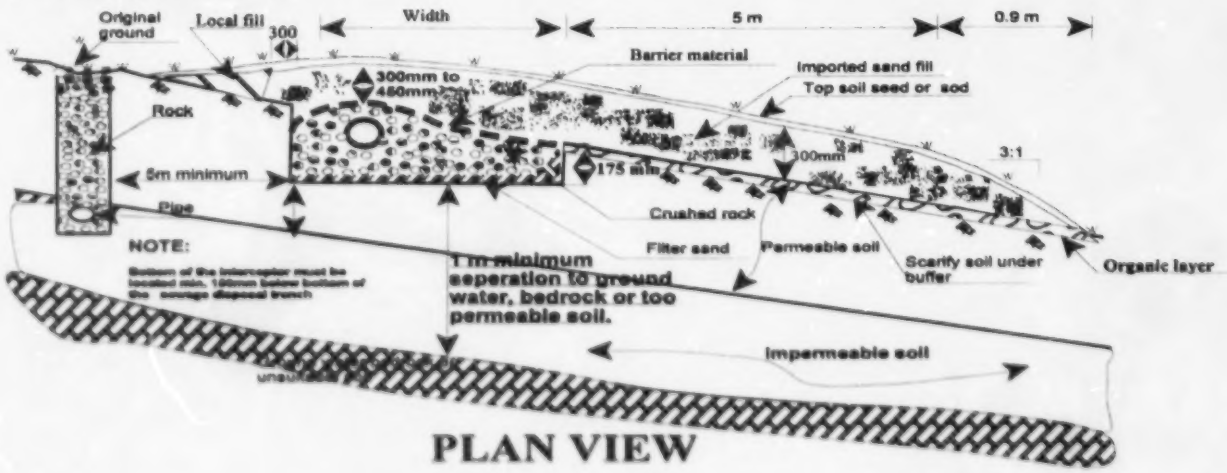
Where ground water, rock, or soil with unacceptably high permeability occurs under a C2 trench, a 1 m vertical separation must be maintained between the bottom of the disposal field trench and the above conditions. This may require the use of a raised C2, or even a C3, rather than a standard C2 to ensure that this 1 m separation is met. In the selection tables for C2 systems, the necessary total depth of soil to bedrock, water table, or soil with unacceptably high permeability is shown as "D".

FIGURE 4.C

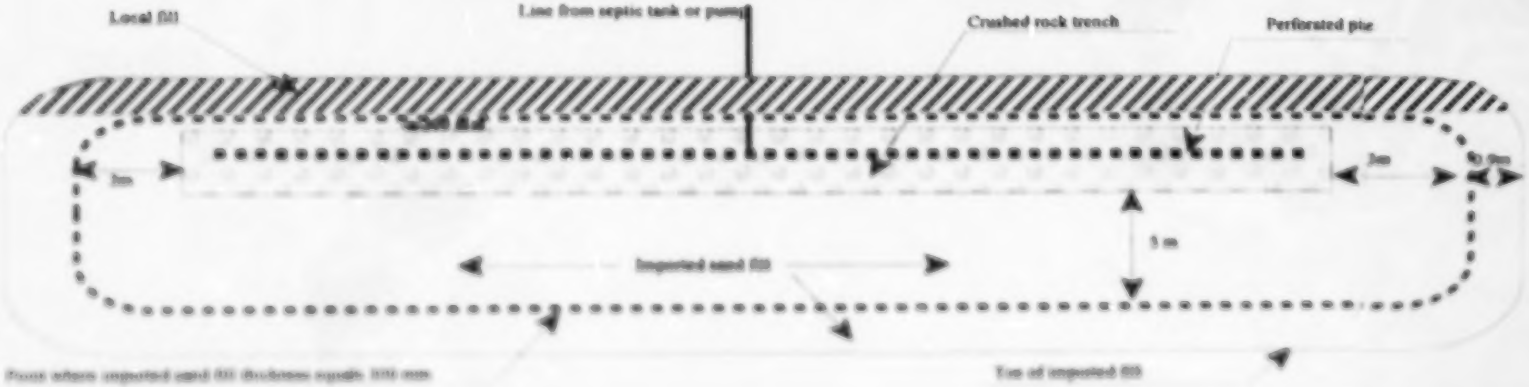
C2 contour disposal field

(Not to scale)

Interceptor/swale must extend a minimum 5 m beyond each end of the disposal field and must provide an adequate surface discharge point for the water



PLAN VIEW



4.6.2.a Layout of Standard C2 Trench

Figure 4.C illustrates the layout of a standard C2 trench.
The toe of the trench is excavated along the contour to a depth of 175 mm. The trench is then excavated to the necessary width while keeping the bottom of the trench perfectly level throughout its length and width. The depth of the trench from the upslope side will be greater than that at the toe.

A 75 mm layer of filter sand meeting the requirements of **Section 3.3.3** is deposited in the bottom of the trench.

A minimum 125 mm depth of crushed rock is deposited on top of the imported sand fill. This will ensure that the distribution pipe is raised so that its invert is at or above the ground elevation at the downslope lip of the trench. The amount of crushed rock at the tee will exceed 125 mm because the pipe will be sloped toward(s) the end(s) of the trench.

4.6.2.b Layout of Raised C2 Trench

Figure 4.D illustrates the layout of a raised C2 trench.

A shallow trench, or key, is excavated along the contour to a depth of 100 mm at the toe. The key is then excavated the necessary width while keeping the bottom of the key perfectly level throughout its length and width. This key will ultimately be filled with filter sand.

The distribution trench is constructed such that at its toe, the bottom of the trench is 100 mm above the natural soil. The toe of the distribution trench is to be directly above the toe of the key. The area between the two is to be made up entirely of filter sand.

The bottom of the distribution trench of crushed rock is to be perfectly level throughout its length and width. There is to be a minimum of 125 mm of crushed rock between the bottom of the distribution trench and the invert of the distribution pipe. The amount of crushed rock at the tee will exceed 125 mm because the pipe will be sloped toward(s) the end(s) of the trench.

The depth of soil for selection of a raised C2 trench is based upon the total depth of unsaturated permeable soil below the organic surface soil. A raised C2 has 200 mm of filter sand under the crushed rock of the distribution trench.

4.6.3 Buffers

Minimum dimensions of buffers in a C2 system are illustrated in **Figures 4.C & 4.D** .

Imported sand fill conforming to Section 3.3.2 must be placed over and downslope of a C2 trench. The depth of sand over the barrier material, and at the downslope limit of the buffer, must be at

least 0.3 m. Fill used for the buffer upslope of the trench may be imported sand fill or another material with lower permeability, such as natural soil excavated from the trench or from the key or clean local backfill. In some cases, lower permeability soil may be preferred for the upslope buffer as it may help keep surface water from entering the disposal field.

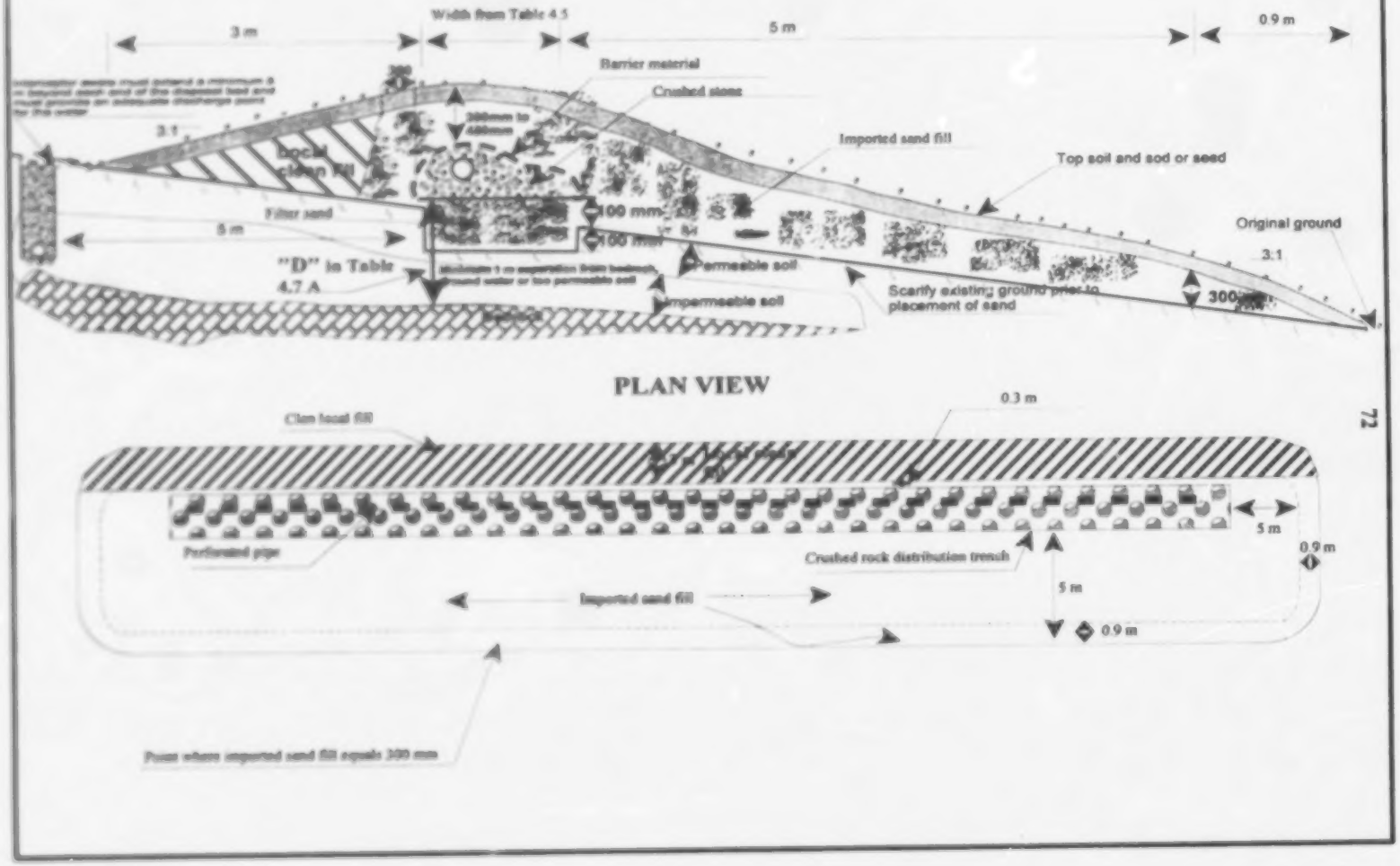
TABLE 4.5

Determination of Disposal Trench Widths in Metres

Length of Trench (m)	Flow (litres per day)	
	1000	1500
	Width in M	Width in M
25	1.2	1.8
26	1.2	1.7
27	1.1	1.7
28	1.1	1.6
29	1	1.6
30, 31	1	1.5
32, 33, 34	0.9	1.4
35, 36	0.9	1.3
37, 38, 39	0.8	1.2
40	0.8	1.1
41, 42, 43	0.7	1.1
44, 45, 46	0.7	1
47	0.6	1
48 - 52	0.6	0.9
53 - 59	0.6	0.8
60	0.6	0.7

FIGURE 4.D

Raised C2



46.4 Interceptor

An interceptor drain or swale, shown in Sections 3.6 and 6.10, must be installed upslope of a C2 system unless the system is at the crest of a hill or there is an existing ditch within 15 m upslope of the system.

4.6.5 Selection of a C2 Trench

The length of a C2 trench is determined using **Tables 4.6.a & b, or 4.7.a, b & c**. The table which is used will depend on the amount of permeable soil, the type of permeable soil, the slope at the location of the trench, the amount of room available for a contour trench on the property and the total depth of soil above water table, bedrock or soil with unacceptably high permeability.

The length of a C2 trench will range between 25 m and 60 m. If a C2 trench cannot be selected through the use of the tables then a C3 trench will have to be considered.

A C2 trench can be selected as follows:

a) Determine the average daily flow, Section 2.6 and **Table 2.3**. In terms of system selection either 1000 L/day or 1500 L/day will be used.

b) Determine the surface slope at the proposed location of the disposal field. If the slope is less than 3 percent or greater than 30 percent, a C2 cannot be considered for selection.

c) Determine the type(s) of permeable soil. If more than one type of permeable soil is present (i.e. 500 mm of sandy gravel and 300 mm of silty sand) the type with the lowest permeability (in this case silty sand) is used for the tables. In the case of more than one permeable soil type, each type can also be used separately when selecting the system type.

d) Determine the depth(s) of permeable soil. If more than one type of permeable soil is present (i.e. 500 mm of sandy gravel and 300 mm of silty sand) the total depth of permeable soil (in this case 800 mm) is used for the tables. If the amount of permeable soil is less than 150 mm, then **Table 4.8** is used. When referring to **Table 4.8**, use the principles discussed in (e) through (i) below .

e) Determine the total depth of soil(s) (soils with acceptable and unacceptable permeability) to water table, bedrock or soil with unacceptably high permeability. If this value is less than 0.95 m, then a C3 or mound system will have to be considered.

f) Refer first to the appropriate chart for standard C2 selection based upon the daily *flow* determined in (a). The daily flow used for each table is in the Title box at the top of each table.

TABLE 4.6A : STANDARD C-2 SYSTEM SELECTION SINGLE FAMILY 3 BEDROOM HOUSE (FLOW = 1000 L/DAY)

SLOPE % L = trench length in meters. D= minimum required depth of soil above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24 to 30
Medium to Coarse Sand OR Fine Sandy Gravel *Permeability*: 20E-6m/s (1.73 m/d)	150 to 299																						
	300 to 449		L=48	L=39	D=1.3 L=33									D=1.4 L= 33									D=1.5 L= 33
	450 to 599	L=43	L=33	L=33																			
	600 +	L=33	L=25	L=25	D=1.3 L=25									D=1.4 L= 25									D=1.5 L= 25
Silty Sand *Permeability*: 8 E-6 m/s (0.69 m/d)	150 to 299																						
	300 to 449							L=54	L=49	L=44	L=41	L=37	L=35										
	450 to 599				L=54	L=46	L=42	L=36	L=33	L=30	L=28	L=33	L=33	L= 33	D= 1.4 L=33									D= 1.5 L=33
	600 to 749			L=49	L=41	L=35	L=30	L=27	D=1.3 L=25					D=1.4 L= 25									D=1.5 L= 25
	750 to 899		L=49	L=39	L=33	L=28																	
	900 to 999	L=54	L=41	L=33	L=27																		
	1000 to 1099	L=49	L=37	L=29																			
	1100 to 1199	L=44	L=33	L=27																			
	1200 to 1299	L=41	L=30	L=25																			
	1300+	L=37	L=28	L=25																			
Sandy Silt *Permeability*: 3E-6 m/s (0.26 m/d)	150 to 299																						
	300 to 449																				L= 59	L= 56	L= 54	L= 52	L= 50	L= 48	L= 46	L= 44
	450 to 599													L= 58	L= 54	L= 51	L= 48	L= 46	L= 43	L= 41	L= 39	L= 38	L= 36	L= 35	D=1.5 L=33			
	600 to 749									L=59	L=54	L=50	L=46	L= 43	L= 41	L= 38	L= 36	L= 34	L= 33	L= 31	L= 30	L= 28	L= 27	L= 26	D=1.5 L=25			
	750 to 899							L=58	L=52	L=48	L=43	L=40	L=37	L= 35	L= 33	L= 31	L= 29	L= 27	L= 26									
	900 to 999						L=54	L=48	L=43	L=39	L=36	L=33	L=31	L= 29	L= 27	L= 26												
	1000 to 1099					L=45	L=42	L=43	L=39	L=35	L=33	L=30	L=28	L= 26	D=1.4 L=25													
	1100 to 1199				L=50	L=51	L=44	L=39	L=35	L=32	L=30	L=27																
	1200 to 1299				L=54	L=46	L=41	L=36	L=33	L=30	L=27	D=1.3 L=25																
	1300+			L=60	L=50	L=43	L=37	L=33	L=28	L=27																		

1) Length (L) selected from the table is a minimum required length of the slope, soil type and depth. It is recommended that system should be made as long as width of the lot permits (not to exceed 60 meters). If length (L) indicated on this table is not available, consider the selection of another type of system
2) If total soil depth "D" is less than indicated in this table, then refer to charts for C-3 selection
3) If more than one type of permeable soil is present in the test pit, use permeable soil with the lowest permeability for selection and total depth of all permeable soils
4) Width of trench (W) is to be determined by referring to Table 4.5

When using a soil type, the permeability shall not be less than that indicated for that particular soil type. [m/s = meters per second; m/d = meters per day; 1 meter = 1000 millimeters = 39.4 inches = 3.28 feet]

D =1.2 | D = 1.3 | D=1.4 | D=1.5

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TABLE 4.6B : STANDARD C-2 SYSTEM SELECTION SINGLE FAMILY 4 BEDROOM HOUSE (FLOW = 1500 L/DAY)

SLOPE % L = trench length in meters, D= minimum required depth of soil above water or bedrock in meters

Soil Type	Depth of Permeable	3	4	5	6	7	8	9	10 to 15	16 to 19	20 to 23	24 to 30
Medium to Coarse Sand OR Fine Sandy Gravel *Permeability:* 20E-4m/s (1.73 m/d)	300 to 449		L=60	L=58	L=48	L=42	L=37					
	450 to 599		L= 37	L=39	D=1.3 L=33				D=1.4 L=33	D=1.5 L=33		
	600 to 749	L= 49	L=39	L=29								
	750 to 899	L=39	L=29	D=1.3 L=25					D=1.4 L=25	D=1.5 L=25	D=1.6 L=25	D=1.7 L=25
	900 +	L=33										
Silty Sand *Permeability:* 8 E-6 m/s (0.69 m/d)	450 to 599							L=54	L=49	L=44	L=4	L=38	L=35	L=33	D = 1.5 L=33	D= 1.6 L=33	
	600 to 749					L=37	L=46	L=41	L=37	L=33	L=3	L=28	L=26				
	750 to 899			L=58	L=48	L=42	L=37	L=33	L=29	L= 27					D=1.5 L=25	D=1.6 L= 25	D=1.7 L= 25
	900 to 999			L=49	L=41	L=35	L=31	L=27									
	1000 to 1099		L=55	L=44	L=37	L=31	L=28		D=1.4 L=25								
	1100 to 1199		L=50	L=40	L=33	L=29											
	1200 to 1299		L=46	L=37	L=30	L=26	D=1.3 L=25										
	1300+	L=36	L=42	L=34	L=28												

		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 to 30
Sandy Silt *Permeability:* 3E-6 m/s (0.26 m/d)	450 to 599																				L= 59	L= 56	L= 54	L= 52	L= 50	L= 48	L= 46	
	600 to 749															L= 57	L= 54	L= 51	L= 49	L= 46	L= 44	L= 42	L= 41	L= 39	L= 38	L= 36	L= 35	L= 34
	750 to 899											L=60	L=56	L= 52	L= 49	L= 46	L= 43	L= 41	L= 39	L= 37	L= 35	L= 34	L= 33	L= 31	L= 30	L= 29	L= 28	L= 27
	900 to 999									L= 59	L= 54	L=58	L=46	L= 43	L= 41	L= 38	L= 36	L= 34	L= 33	L= 31	L= 30	L= 28	L= 27	L= 26				
	1000 to 1099								L= 58	L= 53	L=49	L=45	L=42	L= 39	L= 37	L= 34	L= 33	L= 31	L= 29	L= 28	L= 27	L= 26						
	1100 to 1199							L= 59	L= 53	L= 48	L=44	L=41	L=38	L= 35	L= 33	L= 31	L= 30	L= 28	L= 27	D=1.6 L= 25			D=1.7 L= 25					
	1200 to 1299							L= 54	L= 49	L= 44	L=41	L=38	L=35	L= 33	L= 31	L= 29	L= 27	L= 26										
	1300+						D=1.3	L=58	L=45	L= 41	L=37	L=35	L=32	L= 30	L= 29	L= 27	L= 25	L= 25										

NOTE: 1) Length (L) selected from the table is a minimum required length of the slope, soil type and depth. It is recommended that system should be made as long as width of the lot permits (not to exceed 60 meters). If length (L) indicated on this table is not available, consider the selection of another system

2) If total soil depth "D" is less than indicated in this table, then refer to charts for C-3 selection. [m/s - meters per second m/d - meters per day 1 meter = 1000 millimeters = 39.4 inches = 3.28 feet]

3) If more than one type of permeable soil is present in the test pit, use permeable soil with the lowest permeability for selection and total depth of all permeable soils

4) Width of trench (B) is to be determined by referring to Table 4.5

5) When selecting a soil type, the permeability shall not be less than that indicated for that particular soil type.

KEY:

D=1.2	D=1.3	D=1.4	D=1.5	D=1.6	D=1.7

TABLE 4.7 A
RAISED C-2 SYSTEM SELECTION SINGLE FAMILY 3 BEDROOM HOUSE (FLOW = 1000 L/DAY)

SLOPE %
L = trench length in meters, D= minimum required depth of soil above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10 to 19	20 to 30
Medium to Coarse Sand OR Fine Sandy Gravel *Permeability:* 20E-4m/s (1.73 m/d)	150 to 299		L=48	L=39	D=1.0 L=33				D=1.1 L= 33	D=1.2 L=33
	300 to 599	L=43								
	600 +	L=33	D=1.0 L = 25						D = 1.1 L=25	D=1.2 L=25
Silty Sand *Permeability:* 1 E-6 m/s (0.09 m/d)	150 to 299			L=65	L=46	L=40	L=35		D=1.1 L=33	D=1.2 L=33
	300 to 449		L=54	L=43	L=36					
	450 to 599	L=59	L=44	L=35	D=1.0 L=33					
	600 to 749	L=50	L=37	L=30						
	750 to 899	L=43	L=33	L=26	D=1.0 L=25				D=1.1 L=25	D=1.2 L=25
	900 to 999	L=38	L=29							
	1000 to 1099	L=35	L=27							
	1100 to 1199	L=33								
	1200 +	L=31								
Sandy Silt *Permeability:* 3E-6 m/s (0.26 m/d)	150 to 299				L=56	L=48	L=42	L=38	L=34	D=1.1 L=33 / D=1.2 L=33
	300 to 449			L=60	L=50	L=43	L=38	L=33		
	450 to 599			L=54	L=45	L=38	L=34	L=33		
	600 to 749			L=49	L=41	L=35	L=31	L=27		
	750 to 899		L=56	L=45	L=37	L=32	L=28		D=1.1 L=25 / D=1.2 L=25	
	900 to 999		L=51	L=41	L=34	L=29	L=26			
	1000 to 1099		L=49	L=39	L=33	L=28				
	1100 to 1199		L=46	L=37	L=31	L=27				
	1200 to 1299	L=59	L=44	L=36	L=30					
	1300+	L=56	L=42	L=34	L=28					

Note:
1) Length (L) selected from the table is a minimum required length of the slope, soil type and depth. It is recommended that system should be made as long as width of the lot permits (not to exceed 60 meters). If length (L) indicated on this table is not available, consider the selection of anather type of system.
2) If total soil depth "D" is less than indicated in this table, then refer to charts for C-3 selection.
3) If more than one type of permeable soil is present in the test pit, use permeable soil with the lowest permeability for selection and total depth of all permeable soils.
4) Width of trench (W) is to be determined by referring to Table 4.5.

When selecting a soil type, the permeability shall not be less than that indicated for that particular soil type.

m/s - meters per second m/d - meters per day 1 meter = 1000 millimeters = 39.4 inches = 3.28 feet

D= 1.0 D = 1.1

NOTE: Refer to drawing 4D on page 72 for explanation of "D"

TABLE 4.7 B: RAISED C-2 SYSTEM SELECTION SINGLE FAMILY 4 BEDROOM HOUSE (FLOW = 1500 L/DAY)

SLOPE %

L = trench length in meters, D= minimum required depth of soil above water or bedrock in meters

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10 to 14	15 to 19	20 to 25	26 to 30
Medium to Coarse Sand OR Fine Sandy Gravel *Permeability:* 20E-6m/s (1.73 m/d)	150 to 299			L=58	L=49	L=42	L=37		D=1.1 L= 33	D=1.2 L= 33	D=1.3 L= 33	D=1.4 L= 33
	300 to 449		L= 49	L=39	D=1.0 L=33							
	450 to 599	L= 49	L=37									
	600 to 749	L=39	L=29	D=1.0 L = 25					D=1.1 L=25	D=1.2 L= 25	D=1.3 L= 25	D=1.4 L= 25
	750 +	L=33										
Silty Sand *Permeability:* 8 E-6 m/s (0.69 m/d)	150 to 299					L=59	L=52	L=46	L=42 L=38 L=35	D=1.2 L= 33	D=1.3 L= 33	D=1.4 L= 33
	300 to 449				L=54	L=46	L=41	L=36	D=1.1 L=33			
	450 to 599			L=53	L=44	L=38	L=33	L=33				
	600 to 749		L=56	L=45	L=37	L=32	L=28		D=1.1 L=25	D=1.2 L=25	D=1.3 L= 25	D=1.4 L= 25
	750 to 899		L=48	L=39	L=33	L=28						
	900 to 999	L=57	L=43	L=34	L=29							
	1000 to 1099	L=53	L=40	L=32	L=27	D=1.0 L=25						
	1100 to 1199	L=49	L=37	L=30								
	1200 to 1299	L=46	L=35	L=28								
	1300+	L=43	L=33	L=26								
Sandy Silt *Permeability:* 3E-6 m/s (0.26 m/d)	150 to 299							L=86	L=51 L=46 L=42 L=39 L=36	D=1.2 L=33	D=1.3 L= 33	D=1.4 L= 33
	300 to 449						L=56	L=50	L=45 L=41 L=38 L=35 L=33			
	450 to 599					L=57	L=50	L=45	L=40 L=37 L=34 L=33 L=33			
	600 to 749					L=52	L=46	L=41	L=37 L=33 L=31 L=28 L=26	D=1.2 L=25	D=1.3 L= 25	D=1.4 L= 25
	750 to 899				L=55	L=48	L=42	L=37	L=34 L=31 L=28 L=26			
	900 to 999				L=51	L=44	L=39	L=34	L=31 L=28 L=26			
	1000 to 1099			L=58	L=49	L=42	L=37	L=33	L=29 L=27			
	1100 to 1199			L= 56	L=46	L=40	L=35	L=31	L=28			
	1200 to 1299			L=53	L=44	L=38	L=33	L=30	L=27 D=1.1 L=25			
	1300+			L=51	L=42	L=36	L=32	L=28	L=26			

Note
1. Length (L) selected from the table is a minimum required length of the slope, soil type and depth. It is recommended that system should be made as long as width of the lot permits (not to exceed 60 meters). If length (L) indicated on this table is not available, then refer to charts for C-3 selection
2. If total soil depth "D" is less than indicated in this table, consider the selection of another type of system
3. If more than one type of permeable soil is present in the test pit, use permeable unit with the lowest permeability for selection and total depth of all permeable soils
4. Width of trench (W) is to be determined by referring to Table 4.5

When selecting a soil type, the permeability shall not be less than that indicated for that particular soil type.

KEY: D = 1.0 | D = 1.1

m/s - meters per second m/d - meters per day 1 meter = 1000 millimeters = 39.4 inches = 3.28 fe

Table 4.8 RAISED C2 SYSTEM SELECTION 0 TO 149 MM OF PERMEABLE SOIL *ALL SOIL TYPES*

Slope %
L= length of trench in meters; D= minimum required total natural soil depth above water or bedrock in meters

Flow (l/d)	3	4	5	6	7	8	9	10	11	12	13	14	15
1000					L=56	L=49	L=43	D= 1.1 L=39					
1500								L=58	L=53	L=49	L=45	L=42	L=39
Flow (l/d)	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28 to 30**
1000	D= 1.1 L=39												
1500	D= 1.2 L=39												

Note: m/s - meters per second
m/d - meters per day

Note: **When selecting a soil type, the soil permeability shall not be less than that indicated for that particular soil type.**

Key:

D = 1.1	**D= 1.2**

g) Using the *slope* determined in (b), the *soil type* determined in (c), and the *permeable soil depth* determined in (d), find the values shown for "L" (trench length in metres) and "D" (minimum required total soil depth). For example, in **Table 4.6.a,** a slope of 5%, with 800 mm of silty sand gives a required "L" of 31 m and a required "D" of 1.25 m. If the available contour on the property equals or exceeds "L" and the total depth of soil equals or exceeds "D", then a standard C2 of length "L" can be used. If the available contour on the property is less than "L" or the total depth of soil present is less than "D" then a standard C2 cannot be used. A raised C2 must be considered.

h) When a raised C2 is being considered, refer to the appropriate table for raised C2 selection based upon the daily flow determined in (a).

A Raised C2 is selected as follows:

i) Using the slope determined in (b), the soil type determined in (c), and the permeable soil depth determined in (d), find the values shown for "L" (trench length in metres) and "D" (minimum required total soil depth). For example, in **Table 4.7.a**, a slope of 5%, with 800 mm of silty sand gives a required "L" of 25 m and a required "D" of 1.00 m. If the available contour on the property equals or exceeds "L" and the total depth of soil present equals or exceeds "D", then a raised C2 of length "L" can be used. If the available contour on the property is less than "L" or the total depth of soil present is less than "D", then a raised C2 cannot be used. A C3 or mound system must be considered. **(Sections 4.7 & 4.8)**

j) Once a minimum length "L" of C2 contour trench has been determined, consideration should be given to increasing the length as much as is practical up to a maximum of 60 m. For instance, if the available contour is 30 m, yet the length "L" determined by the table is 25 m, then 30 m should be chosen for the length.

k) Once it has been determined that a standard C2 or raised C2 of a particular length can be used, refer to **Table 4.5**, *Disposal Trench Width in Metres* to find the appropriate width of trench.

l) The cross section dimensions of the disposal field will be as shown in **Figure 4.C** (standard C2) or **Figure 4.D** (raised C2) .

An example of the selection procedure for a C2 and a raised C2 is provided in **Appendix E**.

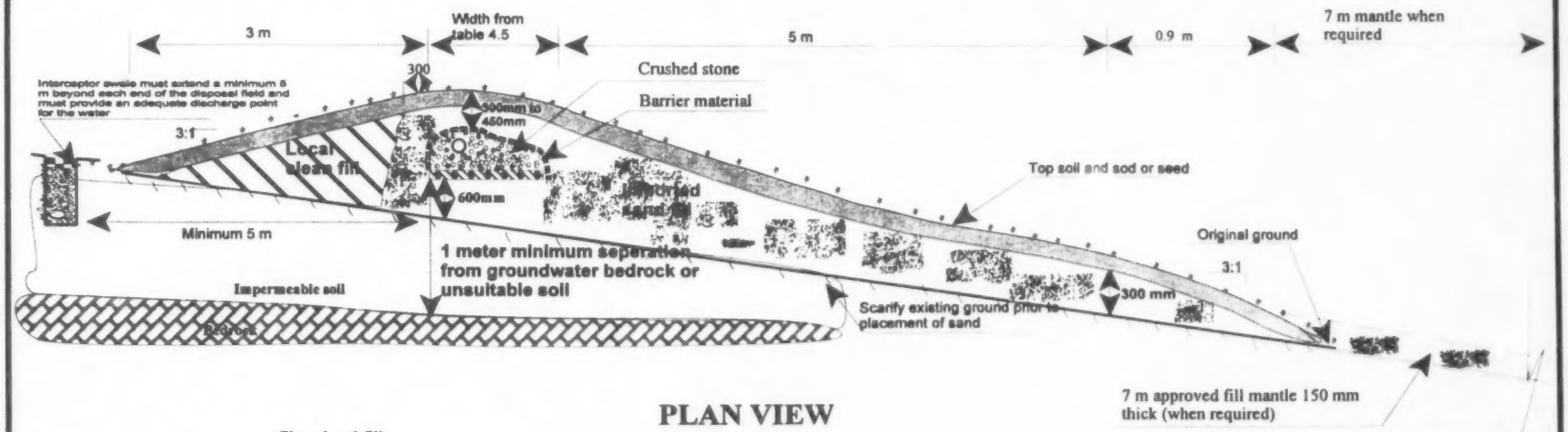
4.7 C3 CONTOUR Trench

4.7.1 Introduction

A C3 trench is shown in **Figures 4.E, 4.F** and **4.K** . This trench consists of a distribution pipe and rock filled trench constructed entirely in imported sand fill. If there is no trench constructed into the existing soil, then the system is always pressurized. The imported sand fill and trench follow the site contour.

FIGURE 4.E

C3 contour disposal field


3 m
Width from table 4.5
5 m
0.9 m
7 m mantle when required
Interceptor swale must extend a minimum 5 m beyond each end of the disposal field and must provide an adequate discharge point for the water
300
Crushed stone
Barrier material
300mm to 450mm
3:1
Local clean fill
600mm
Top soil and sod or seed
Minimum 5 m
1 meter minimum separation from groundwater bedrock or unsuitable soil
Original ground
3:1
Impermeable soil
Bedrock
300 mm
Scarify existing ground prior to placement of sand
7 m approved fill mantle 150 mm thick (when required)

PLAN VIEW

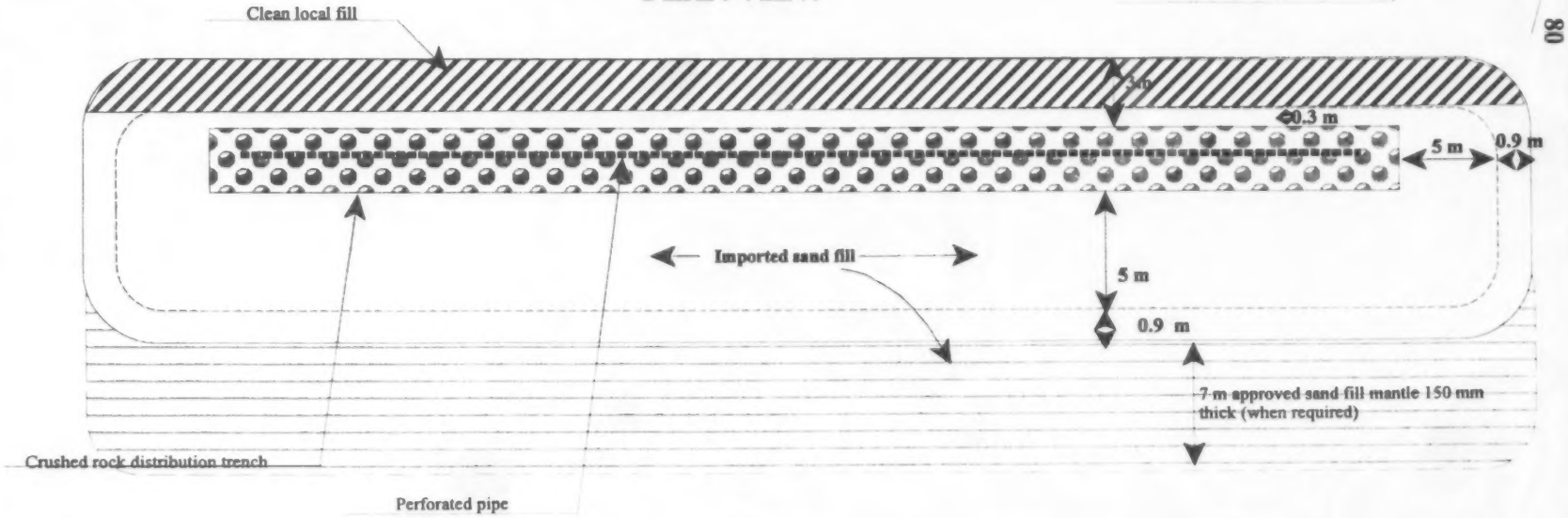
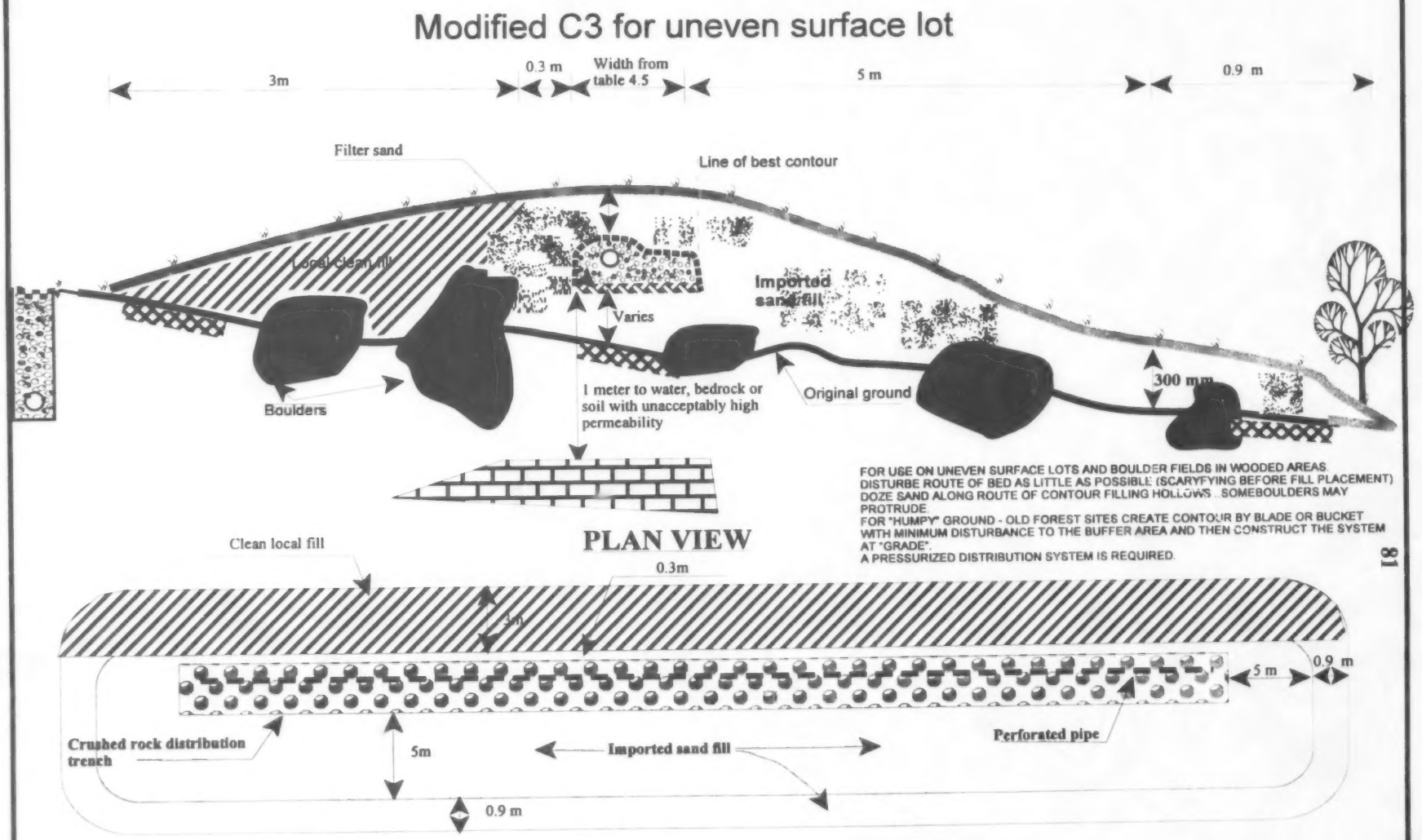


FIGURE 4.F


Modified C3 for uneven surface lot
3m
0.3 m
Width from table 4.5
5 m
0.9 m
Filter sand
Line of best contour
Local clean fill
Imported sand fill
Varies
Boulders
1 meter to water, bedrock or soil with unacceptably high permeability
Original ground
300 mm
FOR USE ON UNEVEN SURFACE LOTS AND BOULDER FIELDS IN WOODED AREAS.
DISTURBE ROUTE OF BED AS LITTLE AS POSSIBLE (SCARYFYING BEFORE FILL PLACEMENT)
DOZE SAND ALONG ROUTE OF CONTOUR FILLING HOLLOWS . SOMEBOULDERS MAY PROTRUDE.
FOR "HUMPY" GROUND - OLD FOREST SITES CREATE CONTOUR BY BLADE OR BUCKET WITH MINIMUM DISTURBANCE TO THE BUFFER AREA AND THEN CONSTRUCT THE SYSTEM AT "GRADE".
A PRESSURIZED DISTRIBUTION SYSTEM IS REQUIRED.
PLAN VIEW
Clean local fill
0.3m
3m
5 m
0.9 m
Crushed rock distribution trench
5m
Imported sand fill
Perforated pipe
0.9 m

A C3 trench may be appropriate where:

- additional depth of imported sand fill is required to protect ground water
- a raised C2 type contour cannot be installed on the site Section 4.6.5
- site conditions—uneven sites including boulder fields, or undulating wooded areas—require a modified C3 system (**Figure 4.F**)instead of a C2 trench
- the surface slope is at least 5%.

Effluent leaving the trench in a C3 is expected to move vertically through the imported sand fill until it reaches the natural soil under the fill. Effluent will then move vertically into the natural soil if the permeability allows, or downslope through the imported sand fill where the permeability of the natural material is inadequate to allow the effluent to enter the soil. Where effluent is expected to discharge from the down slope toe of the imported sand fill, it is important to ensure that there is a sod layer or tree root mat down slope of the toe to receive any discharge.

4.7.2 Layout of a C3 Trench

The required dimensions of the buffers for a C3 trench are shown on **Figures 4.E and 4.F** . Fill used for the buffer upslope of the trench may be imported sand fill or another material with lower permeability. Imported sand fill is required for downslope and end buffers. The downslope edge of the rock trench in the C3 is laid out to follow the contour of the site.

4.7.3 Interceptor

An interceptor drain or swale **(Sections 3.6 and 6.10)** must be installed upslope of a C3 system unless the system is at the crest of a hill or there is an existing ditch within 15 m upstream of the system.

4.7.4 Selection of a C3 Trench

Where ground water, rock or soil with unacceptably high permeability occur under the C3 trench, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the distribution trench and the ground water, rock or soil with unacceptably high permeability. Under these conditions, select a C3 as shown in **Figure 4.E** and **4.F** with a depth of imported sand fill adequate to give the 1 m separation, but not less than 600 mm. For a selection loading of 1000 L/day or less, select a trench 25 m long, 1.2 m wide. If the loading is greater than 1000 L/day but not more than 1500 L/day select a trench 38 m long by 1.2 m wide.

If the C3 is being selected for a site with soil with unacceptably low permeability, and ground water, rock or soil with unacceptably high permeability are not a concern, use a depth of 600 mm imported sand fill under the rock trench. For a selection loading of 1000 L/day or less select a trench 25 m long, 1.2 m wide. If the loading is greater than 1000 L/day but not more than 1500 L/day select a trench 38 m long and 1.2 m wide.

The depth of imported sand fill below the crushed rock in a C3 trench cannot be less than 600 mm, and must not exceed 1000 mm.

The dimensions of a C3 system can be selected as follows:

a. Determine the average daily flow in L/day **(Section 2.6 and Table 2.3.)**
b. Confirm that the ground surface slope at the location of the trench is greater than 5%.
c. If the flow in (a) is 1000 L/day or less, select a trench length of 25 m but if the flow is greater than 1000 L/day but not greater than 1500 L/day, select a trench length of 38 m. The trench width is 1.2 m.
d. If the distance from the bottom of the trench to ground water, bedrock, or soil with unacceptably high permeability is a factor, select the depth of imported sand fill required to give the minimum 1 m separation. Where separation to ground water, bedrock, or soil with unacceptably high permeability is not a concern select a depth of 600 mm imported sand fill under the trench.
e. Select other dimensions of the system from **Figures 4.E** and **4.F**

All C3 type systems are pressurized. For information on pump or siphon requirements see Section 3.1.3, 3.4 and 3.5. The length of perforated pipe in the C3 serving a single family home is either 25 or 38 m. For either of these systems select solid 75 or 100 mm pipe, seal all joints with solvent cement and drill 13 mm holes in the pipe invert spaced as follows:

TABLE 4.9

C3 Trench SELECTION

Distribution Pipe Length	Number of Holes	Hole Spacing
25 m length	20 holes	centre of first hole .625 m from the ends of the pipe then spaced 1.25 m on centres
38 m length	30 holes	centre of first hole .875 m from the ends of the pipe then spaced 1.25 m on centres

Cap the ends of the pipe and drill a 13 mm hole in the top of the pipe 150 mm from each end to allow air to escape when the pump or siphon discharges. In an attempt to maximize distribution, the perforated pipe should be centre fed. Ensure any burrs are cleaned out of drilled holes.

Where a C3 type system is installed on a lot with very little permeable soil over solid bedrock or

soil with unacceptably low permeability and effluent is expected to be obvious at the down slope toe of the sand buffer it is recommended that a 150 mm layer of sand plus topsoil and sod be extended beyond the buffer. The down slope width of this extra buffer is determined on a site by site basis but should extend at least 7 m or to the point where there is adequate permeable soil or root zone to absorb the effluent.**(Figure 4E)**

NOTE: The only difference in the selection of a C3 or a mound is that a mound is only suitable on slopes of less than 5% and a C3 is only suitable on slopes of 5% or greater. The only difference in the construction of a mound and a C3 is in the type of material that can be used in the up slope buffer.

An example of the selection procedure for a C3 is provided in **(Appendix E)** .

4.8 MOUND SYSTEM SELECTION

4.8.1 Introduction

The dimensions of a mound system are shown in **Figure 4.G** . A mound system is constructed entirely above ground on flat surfaces (lots with less than 5% slope). Effluent leaving the trench in the mound will move vertically through the imported sand fill. Effluent will then move vertically into the natural soil if the permeability allows, or laterally through the imported sand fill toward the toe of the imported sand fill where the permeability of the natural soil is inadequate to allow the effluent to enter the soil. In this case it is possible that effluent will exit the toe of imported sand fill on either side or end. Where effluent is expected to discharge from the toe, it is important to assure that there is a sod layer or tree root mat beyond the toe to receive any discharge. A mound system must be pressurized by a pump or siphon.

A mound system should be considered where:

- the slope is less than 5 % **(Table 4.3)**
- the depth of unsaturated permeable soil is less than the minimum required to install any of the other type of system **(Table 4.2)**
- additional depth of imported sand fill is required to provide the required vertical separation over ground water, rock, or soil with unacceptably high permeability.

Where ground water, rock, or soil with unacceptably high permeability occurs under a mound system, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the distribution trench and the ground water, rock or soil with unacceptably high permeability.

4.8.2 Layout of Mound Systems

Figure 4.G illustrates a mound system. Features of the system include:

- the mound should be laid along any contour that exists on the site, however minimal the slope may be.
- the trench width is 1.2 m
- the minimum length of the distribution pipe is 25 m for a flow of 1000 L/day, and 38 m for a flow greater than 1000 L/day but not more than 1500 L/day

4.8.3 Interceptors

An interceptor drain or swale **(Sections 3.6** and **6.10)** must be installed upslope of a mound unless the system is near the crest of a hill or there is an existing ditch within 15 m upslope of the system.

4.8.4 Selection of a Mound System

The depth of imported sand fill below the crushed rock in a mound system cannot be less than 600 mm, and must not exceed 1000 mm.

The dimensions of a mound system can be selected as follows.

a) Determine the average daily flow in L/day **Section 2.6** and **Table 2.3**
b) Confirm that the ground surface slope at the location of the system is less than 5%.
c) If the flow in (a) is 1000 L/day or less, select a trench length of 25 m, but if the flow is greater than 1000 L/day but not greater than 1500 L/day, select a trench length of 38 m.
d) If the distance from the bottom of the trench to ground water, bedrock, or soil with unacceptably high permeability is a factor select the depth of imported sand fill required to give the minimum 1 m separation. Where separation to ground water, bedrock, or soil with unacceptably high permeability is not a concern select a depth of 600 mm imported sand fill under the trench.
e) Select other dimensions of the system from **Figure 4.G.**

All mound type systems are pressurised. For information on pump or siphon requirements see **section 3.1.3, 3.4** and **3.5**. The length of perforated pipe in a C3 serving a single family home is either 25 or 38 m. For either of these systems select solid 75 or100 mm pipe, seal all joints and fix the end caps with solvent cement and drill 13 mm holes in the pipe invert spaced as follows:

TABLE 4.10

MOUND SYSTEM SELECTION

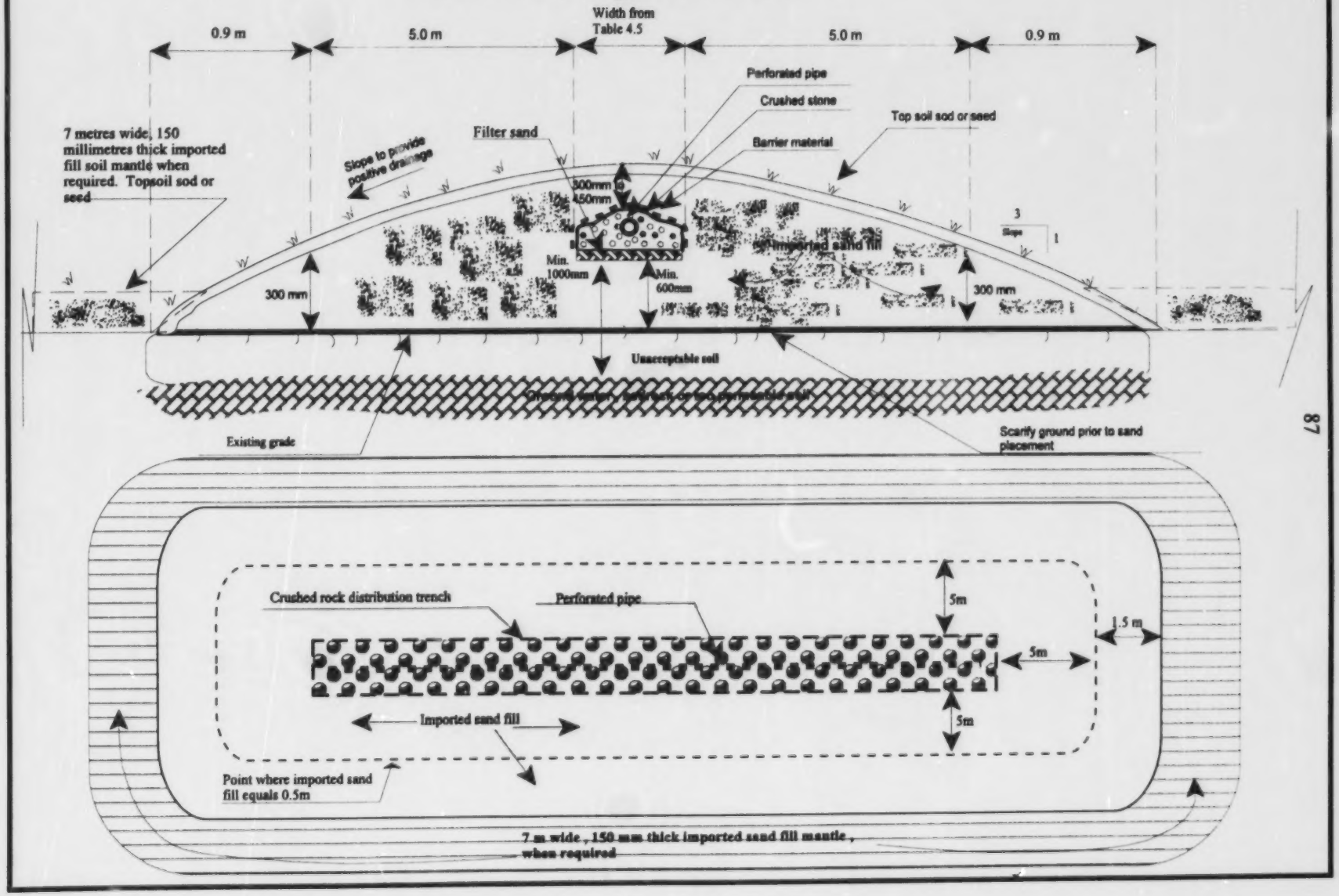
Distribution Pipe Length	Number of Holes	Hole Spacing
25 m length	20 holes	centre of first hole .625 m from the ends of the pipe then spaced 1.25 m on centres
38 m length	30 holes	centre of first hole .875 m from the ends of the pipe then spaced 1.25 m on centres

Cap the ends of the pipe and drill a 13 mm hole in the top of the pipe 150 mm from each end to allow air to escape when the pump or siphon discharges. In an attempt to maximize distribution, the perforated pipe should be centre fed. It is important that the tee connection and all the distribution pipe be perfectly level. Ensure any burrs are cleaned out of drilled holes.

Where a mound type system is installed on a lot with very little permeable soil over solid bedrock or soil with unacceptably low permeability and effluent is expected to be obvious at the toe of the sand buffer, it is recommended that a 150 mm layer of sand plus topsoil and sod be extended beyond the buffer. The width of this extra buffer is determined on a site by site basis but should extend at least 7 m, or to the point where there is adequate permeable soil or root zone to adsorb the effluent.

FIGURE 4.G

Mound disposal field



NOTE: The only difference in the selection of a C3 or a mound is that a mound is only suitable on slopes of less than 5% and a C3 is only suitable on slopes of 5% or greater. The only difference in the construction of a mound and a C3 is in the type of material that can be used in the up slope buffer.

An example of this selection procedure for a mound is provided in **Appendix E**.

If a mound system cannot be selected on the basis of this section, refer to Section 5 - Disposal Field Design. It should be noted that under some site conditions it may not be possible to develop a property utilizing an on- site sewage disposal system.

4.9 AREA BED AND MULTIPLE TRENCH SYSTEMS

4.9.1 Introduction

Area bed and multiple trench systems distribute effluent over a horizontal area from which it is expected to move vertically through subsurface soils. The sizing of these systems is based on traditional loading rates and experience. The system sizes cannot be verified based on soil hydraulics, unlike the sizing of the contour type systems. Their selection under conditions where contour systems are suitable is not encouraged. These systems may be selected when the site slope is less than or equal to 3%.

An interceptor trench or swale may be necessary where an area bed or multiple trench system is located at the lower end of a long slope.

4.9.2 Selection and Layout of a Area Bed

An area bed, shown in **Figure 4.H and 4.K** is a rectangular excavation that contains perforated pipe underlain and surrounded by crushed rock. The crushed rock is separated from the soil cover by a geotextile barrier. A 75 mm layer of filter sand must be placed beneath the crushed rock.

As indicated in **Figure 4.H**, all piping is to be perforated in the distributed bed, except the header is to be solid. The excavation should be oriented with the greatest dimension across the slope of the lot. The bottom of the excavation should be truly level. The header is sloped away from the tee and footer pipe is laid level to ensure equal distribution. The slope on the header must meet the specified drop of between 50 and 100 mm per 30 metres.

To use an area bed type field the following conditions must be met:

1) The slope on the lot does not exceed 3%
2) There is at least 600 mm of permeable soil on the lot.

3) There is at least 600 mm of permeable soil under the bed (bottom of excavation) over impermeable soil.
4) There is at least 1m separation between the bottom of the area bed and the maximum water table elevation, bedrock or soil with unacceptably high permeability.
5) The bed (bottom of excavation) is not more than 800 mm deep.
6) Where the bottom of the excavation must be raised to maintain the separation distances outlined in 3) or 4), the bottom of excavation should not be raised above the bottom of the organic layer, ie. the bed is notched into the organic layer.

Where these conditions cannot be met another type of system such as a mound can be considered.

Where there is **more than 1.65 m of permeable soil above watertable or bedrock**, a fully trenched area bed can be installed.

Where there is **between 1.65m and 1m of permeable soil above watertable, bedrock or soil with unacceptably high permeability** the excavation can be made shallower to maintain the 1 m separation to the restrictive layer with the pipe invert still being 150 above bed bottom. In this case the bed must be covered to a level above original grade to provide a minimum 375 mm cover over the pipe.

Where there is **more than 1250 mm of permeable soil above soil with unacceptably low permeability**, a fully trenched system can be installed.

Where there is **between 1250 mm and 600 mm of permeable soil above soil with unacceptably low permeability**, the excavation can be made shallower to maintain the 600 mm of permeable soil beneath the excavation, the pipe invert still being 150 above trench bottom. In this case the trenches must be cover to a level above original grade to provide a minimum 375 mm cover over the pipe.

Once it has been determined that conditions allow the installation of an area bed system, the minimum area and minimum cross slope dimension can be selected from **Table 4.9** for either 1000 L/day or 1500 L/day based on the soil type determined from the test pit information.

TABLE 4.9

AREA BEDS SELECTION

MINIMUM AREAS AND CROSS SLOPE DIMENSIONS

(USE LARGER AREAS WITH LONGER CROSS SLOPE DIMENSION WHERE POSSIBLE)

SOIL TYPE	FLOW - 1000 L/DAY	FLOW - 1500 L/DAY
Medium to Course Sand or Fine Sandy Gravel	75 m^2 - 15 metres across slope x 5 metres wide	110 m^2 - 22 metres across slope x 5 metres wide
Silty Sand	100 m^2 - 20 metres across slope x 5 metres wide	150 m^2 - 30 metres across slope x 5 metres wide
Sandy Silt	125 m^2 - 25 metres across slope x 5 metres wide	180 m^2 - 30 metres across slope x 6 metres wide

Note: The perforated pipe in the area bed should be installed such that there is a maximum separation from the wall of the excavation of 1.5 m to the pipe and the maximum separation distance between rows of pipe is 3 m.

The dimensions of an area bed system may be selected as follows:

a) Determine the average daily flow in L/day from Section 2.6 and **Table 2.3**.
b) Confirm that the ground surface slope at the location of the field is less than 3%
c) From the test pit information determine soil type, depth of permeable soil and depth of soil to any restrictive layer.
d) Determine if conditions in c) allow the selection of an area bed field and if so determine the depth of excavation required to maintain 600 mm permeable soil under the trench and 1m separation to bedrock, maximum water table elevation and soil with unacceptably high permeability.
e) If conditions allow the selection of an area bed, select the size of the bed suitable for the soil conditions from **Table 4.9**.
f) Refer to Section 6 for system construction details. Refer to **Figure 4.H and 4.K** for typical layout of an area bed system.

FIGURE 4.H

Area Bed disposal system

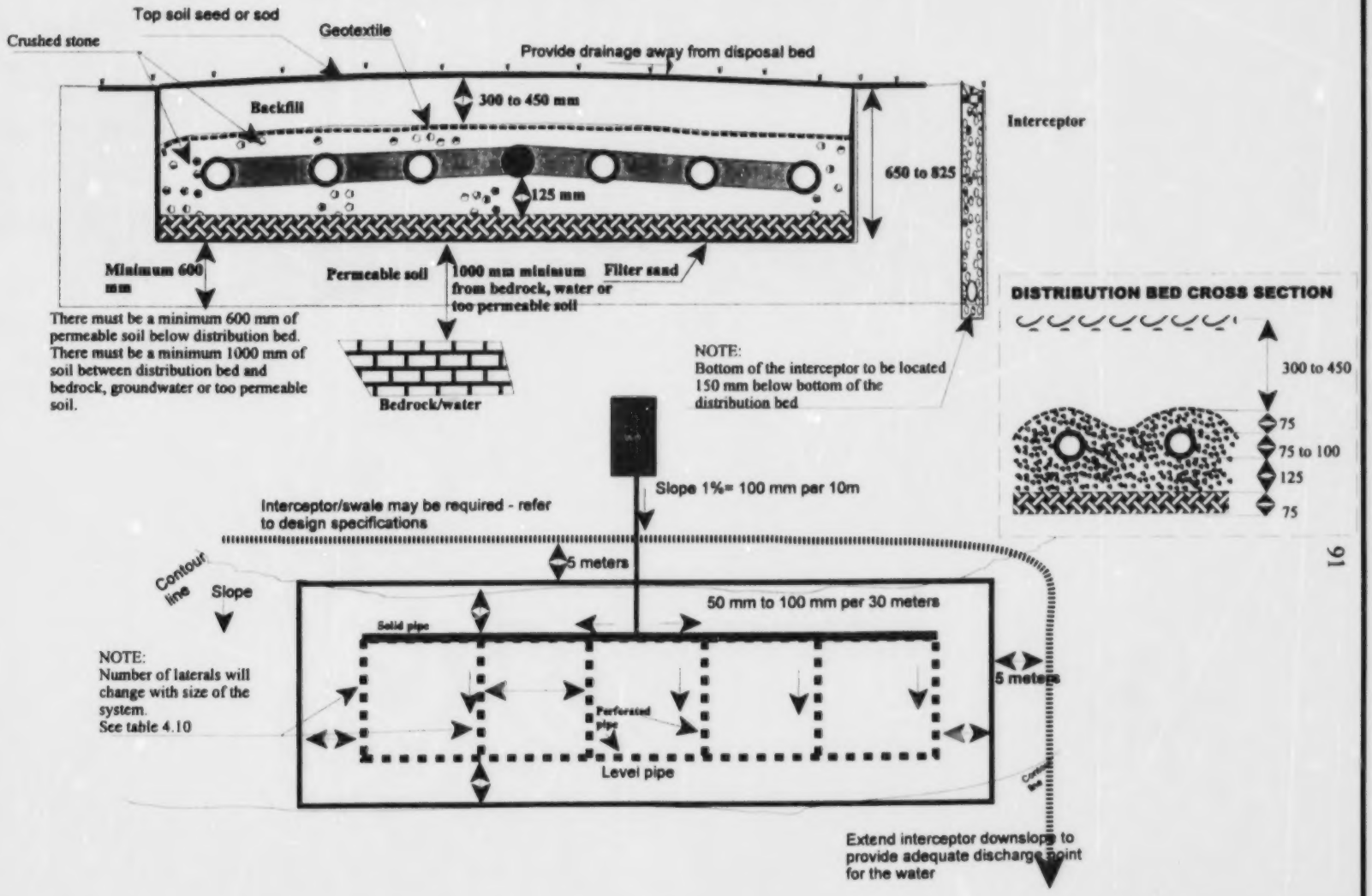
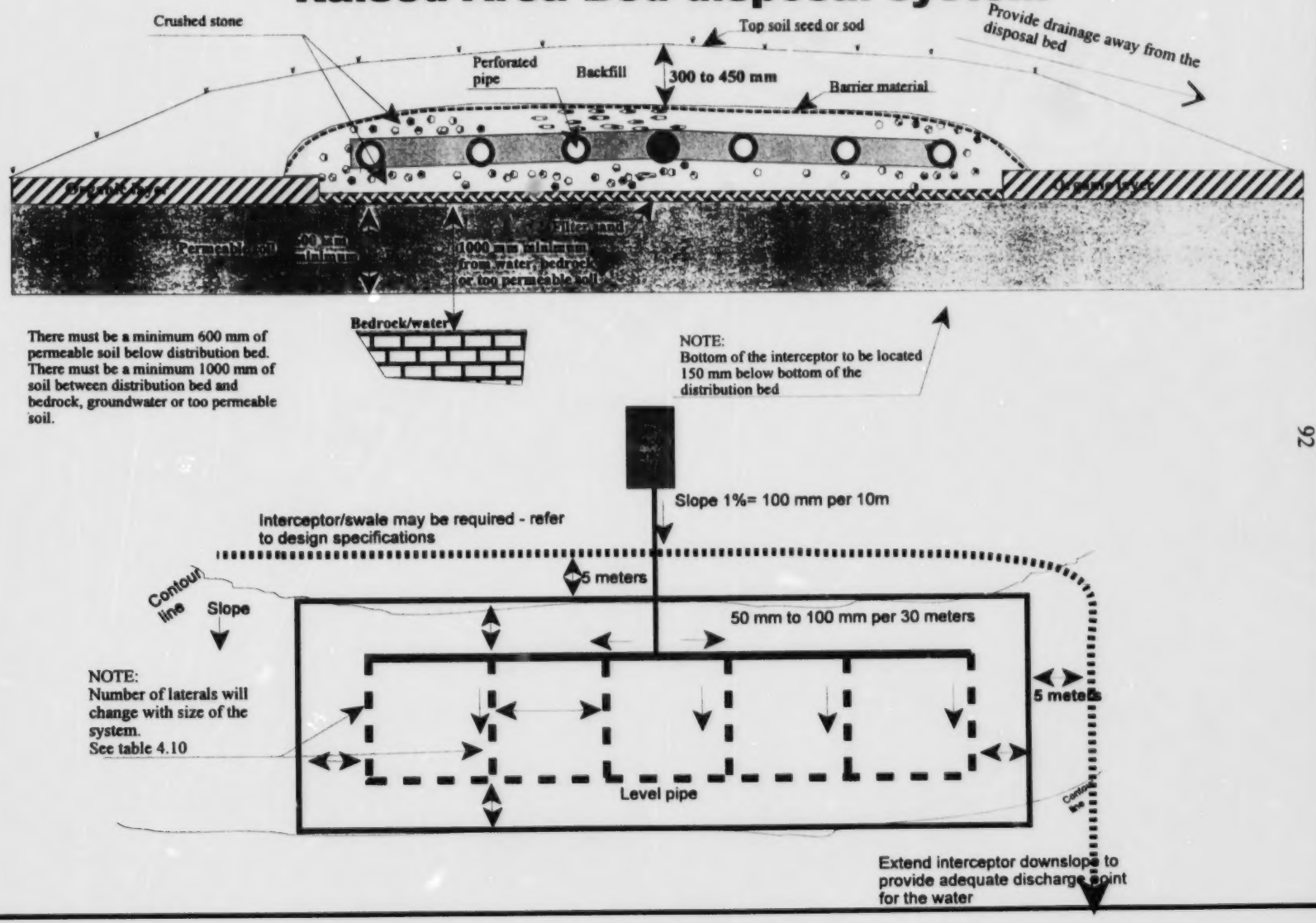

Top soil seed or sod
Crushed stone
Geotextile
Provide drainage away from disposal bed
Backfill
300 to 450 mm
125 mm
650 to 825
Interceptor
Minimum 600 mm
Permeable soil
1000 mm minimum from bedrock, water or too permeable soil
Filter sand
There must be a minimum 600 mm of permeable soil below distribution bed. There must be a minimum 1000 mm of soil between distribution bed and bedrock, groundwater or too permeable soil.
Bedrock/water
NOTE:
Bottom of the interceptor to be located 150 mm below bottom of the distribution bed
DISTRIBUTION BED CROSS SECTION
300 to 450
75
75 to 100
125
75
Slope 1%= 100 mm per 10m
Interceptor/swale may be required - refer to design specifications
5 meters
Contour line
Slope
50 mm to 100 mm per 30 meters
Solid pipe
Perforated pipe
Level pipe
5 meters
NOTE:
Number of laterals will change with size of the system.
See table 4.10
Extend interceptor downslope to provide adequate discharge point for the water

FIGURE 4.H continued

Raised Area Bed disposal system


Crushed stone
Top soil seed or sod
Provide drainage away from the disposal bed
Perforated pipe
Backfill
300 to 450 mm
Barrier material
Bedrock/water
There must be a minimum 600 mm of permeable soil below distribution bed. There must be a minimum 1000 mm of soil between distribution bed and bedrock, groundwater or too permeable soil.
NOTE:
Bottom of the interceptor to be located 150 mm below bottom of the distribution bed
Slope 1%= 100 mm per 10m
Interceptor/swale may be required - refer to design specifications
5 meters
Contour line
Slope
50 mm to 100 mm per 30 meters
NOTE:
Number of laterals will change with size of the system.
See table 4.10
5 meters
Level pipe
Extend interceptor downslope to provide adequate discharge point for the water

4.9.3 Selection and Layout of a Multiple Trench

A multiple trench system, shown in **Figure 4.I**, is a network of shallow trenches containing perforated pipes surrounded by crushed rock. The crushed rock is separated from the soil cover by a geotextile barrier. A 75 mm layer of filter sand must be placed under the crushed rock.

As indicated in **Figure 4.I**, a solid header and a perforated footer pipe (optional) are joined by a number of perforated laterals. The trenches should be oriented with the greatest dimension across the slope of the lot. The header pipe must be sloped away from the tee and footer pipes are laid level to ensure equal flow distribution to the laterals. The bottom of the lateral trenches should be truly level. The slope on the header pipes must meet the specified drop of between 50 and 100 mm per 30 metres.

The width of trenches are a minimum of 600 mm for selection purposes. Wider trenches can be used if desired. Lateral trenches should be installed 3 metres apart where site conditions allow. Trenches can be closer together if special care is taken to ensure excavated material from one trench does not fall into the next trench.

To use a trench type disposal field the following conditions must be met:

1) The slope on the lot does not exceed 3%
2) There is at least 750 mm permeable soil on the lot.
3) There is at least 600 mm permeable soil under the trench over impermeable soil.
4) There is at least 1m separation between the bottom of the trench and the maximum water table elevation, bedrock or soil with unacceptably high permeability
5) The trench depth is no more that 800 mm and no less than 150 mm.

Where these conditions cannot be met the selection of another type of disposal field such as a mound may be considered.

Where there is **more than 1.65 m of permeable soil above watertable or bedrock**, a fully trenched system can be installed.

Where there is **between 1.65m and 1.15 of permeable soil above watertable, bedrock or soil with unacceptably high permeability** the trenches can be made shallower to maintain the 1 m separation to the restrictive layer with the pipe invert still being 150 above trench bottom. In this case the trenches must also be covered to a level above original grade to provide a minimum 375 mm cover over the pipe.

Where there is **more than 1250 mm of permeable soil above soil with unacceptably low permeability**, a fully trenched system can be installed.

Where there is **between 1250 mm and 750 mm of permeable soil above soil with**

unacceptably low permeability, the trenches can be made shallower to maintain the 600 mm of permeable soil beneath the trench, the pipe invert still being 150 above trench bottom. In this case the trenches must be cover to a level above original grade to provide a minimum 375 mm cover over the pipe.

Once it has been determined that conditions allow the installation of a trench type system, the minimum total length of trench can be selected from **Table 4.10** for either 1000 L/day or 1500 L/day based on the soil type determined from the test pit information

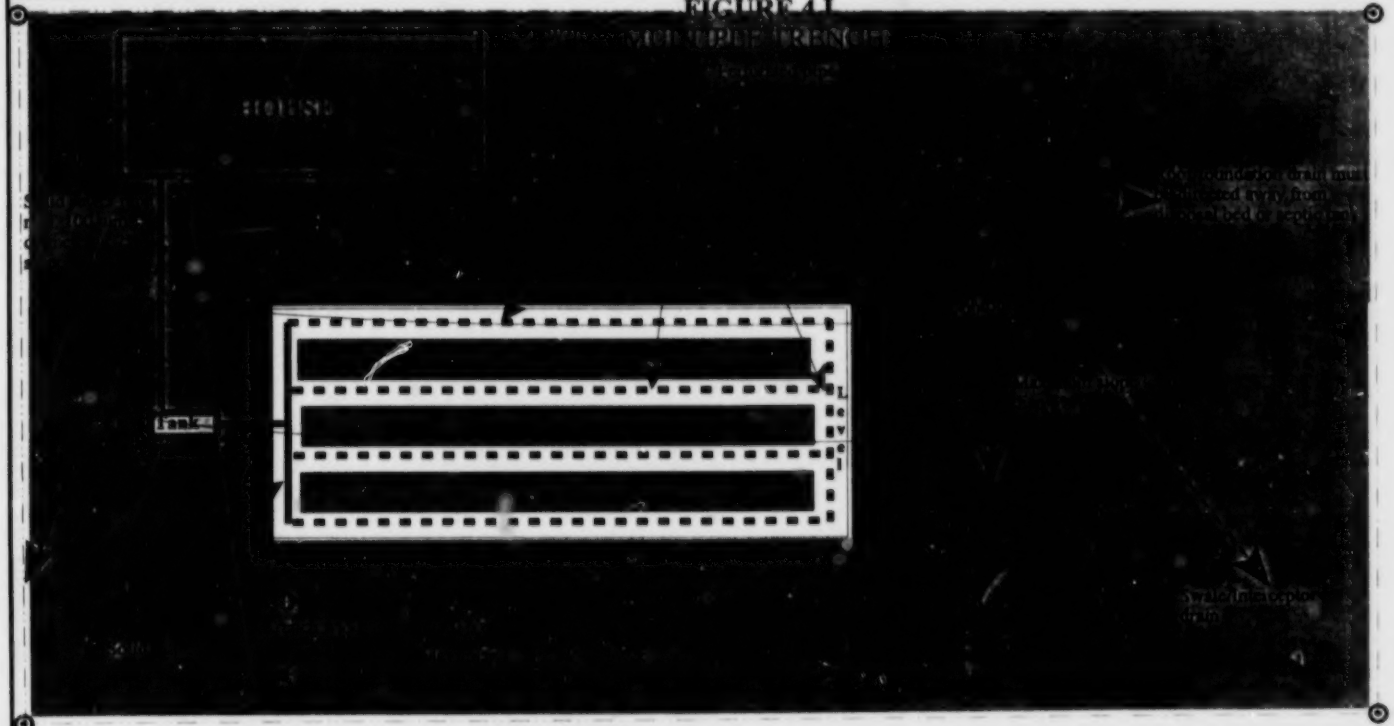
TABLE 4.10
MULTIPLE TRENCH SELECTION
MINIMUM LENGTH OF TRENCH WITH A MINIMUM TRENCH WIDTH OF 600 MM
(USE LONGER ROWS WHERE POSSIBLE)

Soil Type	Flow 1000 L/day	Flow 1500 L/day
Medium to Coarse Sand or Fine Sandy Gravel	Total length = 64m. Use 2 rows 32 m long or 4 rows 16 m long	Total length = 96m. Use 4 rows 24 m long.
Silty Sand	Total length = 80m. Use 4 rows 20 m long.	Total length = 120 m. Use 4 rows 30m long.
Sandy Silt	Total length = 100m. Use 4 rows 25m	Total length = 150 m. Use 4 rows 37.5 m long.

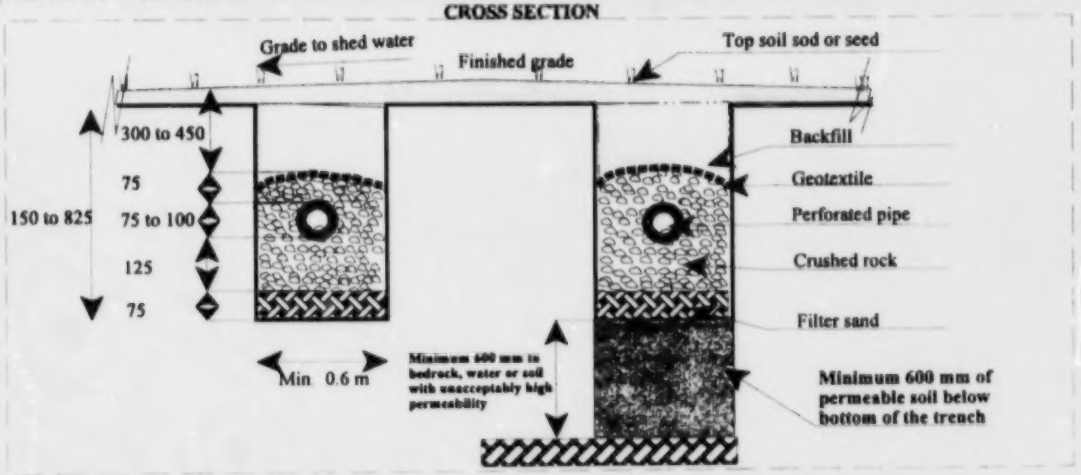
The dimensions of a multiple trench system may be selected as follows:

a. Determine the average daily flow in L/day from **Section 2.6 and Table 2.3.**
b. Confirm that the ground surface slope at the location of the bed is less than or equal to 3%.
c. From the test pit information determine soil type, depth of permeable soil and depth of soil to any restrictive layer.
d. Determine if conditions in c. allow the selection of a trench type field and if so determine the depth of trench required to maintain 600 mm permeable soil under the trench and 1m separation to bedrock, maximum water table elevation and soil with unacceptably high permeability.
e. If conditions allow the selection of a trench type system, select the multiple trench system suitable for the soil conditions from **Table 4.10.**
f. Refer to Section 6 for system construction details. Refer to **Figure 4.I** for typical layout of a multiple trench system.

FIGURE 4.1



CROSS SECTION



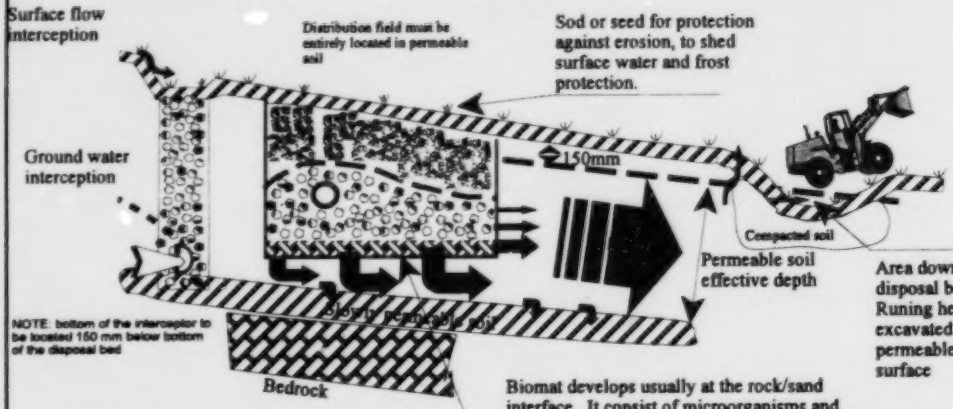
NOTE:

Determine total length of trench required based on site conditions from Table 4.10. Then lay out trenches as long as possible , up to 33 meters each and follow contour of the lot as closely as possible. An even number of trenches allows system to be center fed for better distribution . Join lower ends of pipe with perforated pipe.

FIGURE 4.J

DISPOSAL SYSTEMS PRINCIPLE OF OPERATION C1

C1 systems are design to contain flow entirely within effective soil depth and transport it lateraly downslope.


Surface flow interception
Distribution field must be entirely located in permeable soil
Sod or seed for protection against erosion, to shed surface water and frost protection.
Ground water interception
150mm
Compacted soil
Permeable soil effective depth
NOTE: bottom of the interceptor to be located 150 mm below bottom of the disposal bed
Bedrock

Area downslope of any type of disposal bed must be left undisturbed. Runing heavy equipment, stockpiling excavated soil etc. may compact permeable soil, and force effluent to surface

Biomat develops usually at the rock/sand interface. It consist of microorganisms and organic material. Permeability of biomat is lesser than that of surrounding soil. Biomat assist in treatment of sewage.

C2

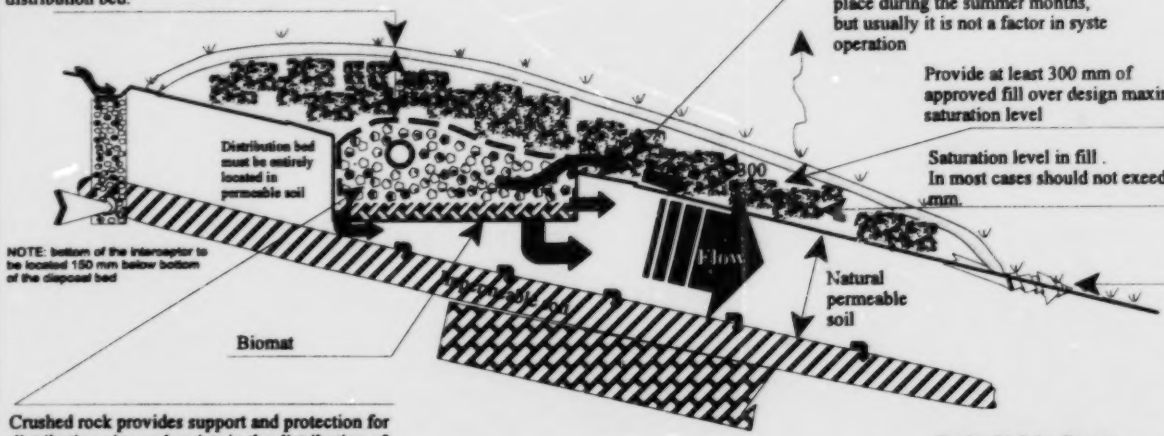
300 mm to 450 mm of soil cover above the distribution bed is required for frost protection. Excessive soil cover (+450mm) may deplete air supply to distribution bed.

In C2 type disposal beds excess flow overflows into buffer after saturating natural permeable soil.

Some evapotranspiration will take place during the summer months, but usually it is not a factor in syste operation

Provide at least 300 mm of approved fill over design maximum saturation level

Saturation level in fill . In most cases should not exeed 100 mm.


Distribution bed must be entirely located in permeable soil
300
NOTE: bottom of the interceptor to be located 150 mm below bottom of the disposal bed
Natural permeable soil
Biomat

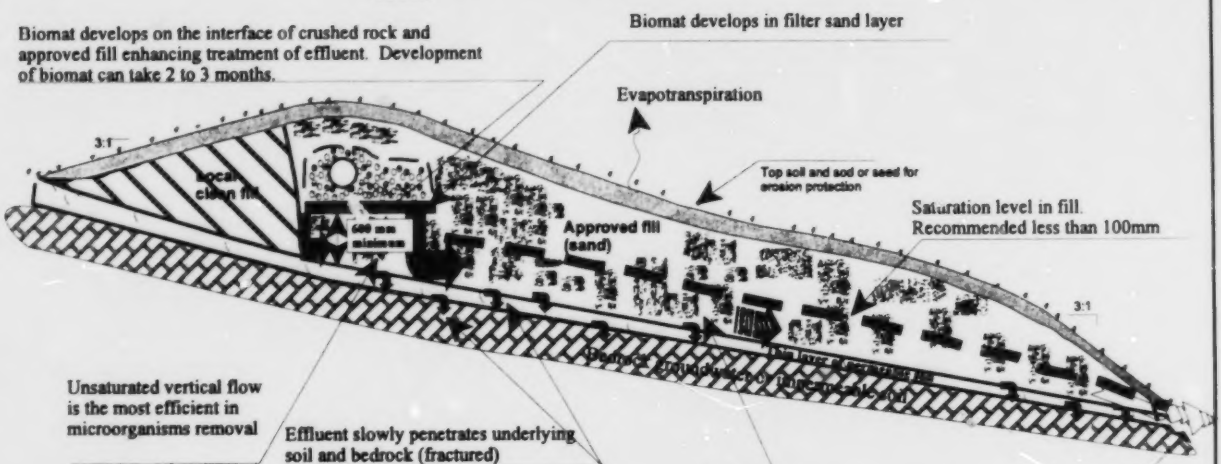
Crushed rock provides support and protection for distribution pipe and assists in the distribution of the effluent over the disposal area. In pressurized systems it also dissipates flows to prevent erosion of the distribution bed.

During high loading or precipitation periods partially treated effluent may emerge at the toe of the buffer as thin film flow in the root zone.

FIGURE 4.K

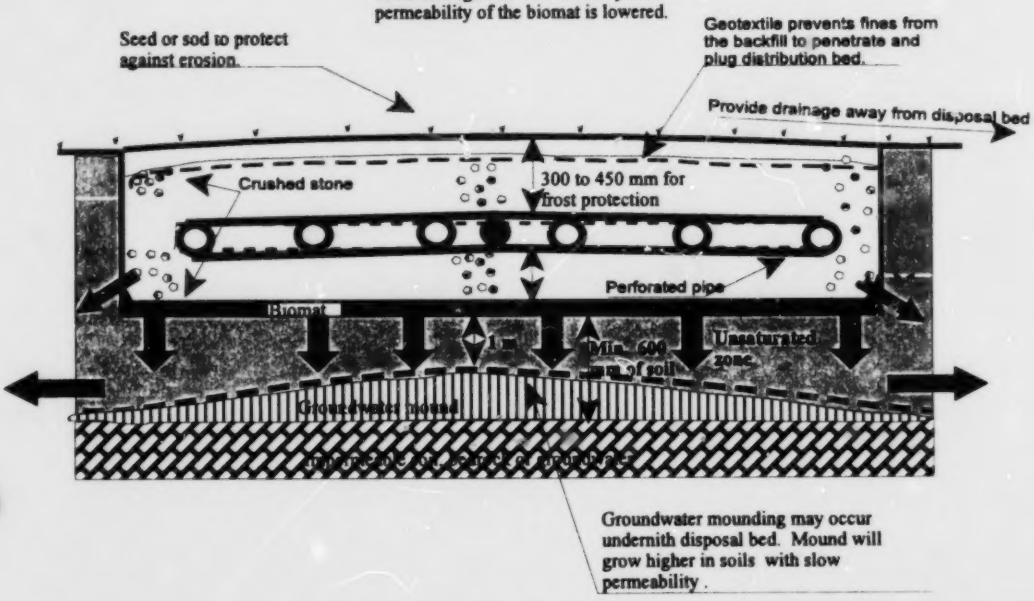
DISPOSAL SYSTEMS PRINCIPLE OF OPERATION C3

In C3 type systems majority of the flow goes through approved imported fill placed on site.


Biomat develops on the interface of crushed rock and approved fill enhancing treatment of effluent. Development of biomat can take 2 to 3 months.
Biomat develops in filter sand layer
Evapotranspiration
Top soil and sod or seed for erosion protection
Saturation level in fill. Recommended less than 100mm
3:1
Local clean fill
600 mm minimum
Approved fill (sand)
3:1
Unsaturated vertical flow is the most efficient in microorganisms removal
Effluent slowly penetrates underlying soil and bedrock (fractured)
Saturated horizontal flow
Possible effluent seepage

AB or MT

In area bed (AB) or multiple trench systems (MT) flow percolates vertically downwards to groundwater table. Some flow may also occur through sidewals of the system if permeability of the biomat is lowered.


Seed or sod to protect against erosion.
Geotextile prevents fines from the backfill to penetrate and plug distribution bed.
Provide drainage away from disposal bed
Crushed stone
300 to 450 mm for frost protection
Perforated pipe
Biomat
Min. 600 mm of soil
Unsaturated zone
Groundwater mound
Groundwater table

Groundwater mounding may occur undernith disposal bed. Mound will grow higher in soils with slow permeability.

4.10 HOLDING TANK SELECTION

A holding tank can only be selected by a QP2 providing the manufacturer of that tank has met the design and installation specifications established by the department and the manufacturer has obtained prior confirmation of this compliance from the department. The QP2 shall includes all relevant manufactures information and instructions for installation for the site conditions with any application for approval to install a holding tank.

Such design specifications include, but are not limited to the following:

1) The tank must conform to the latest edition of Standard CAN/CSA-B66-M90, published by the Canadian Standards Association and be non metallic.

2) The manufacture shall supply details on required tank anchorage and tie downs for different depths of final tank soil cover, this is assuming empty tank conditions and water table to ground surface.

3) The manufacturer shall supply details on a tank clean out that extends above finished grade, has a lockable water tight closure, and is protected from damage due to potential differential movement of soils due to frost action. This clean out shall be free of joints or any joints shall be made water tight with gaskets and have mechanical fasteners.

4) The manufacture shall specify maximum and minimum depth of cover and any related restrictions on traffic load.

2) The manufacturer shall supply detailed excavation, bedding installation and backfilling requirements.

3) The holding tank must be constructed such the highest water level in the tank does not exceed any horizontal joint unless such joint is made water tight with gaskets and mechanical fasteners. See testing procedures Section 3.A of the latest edition of Standard CAN/CSA-B66-M90, published by the Canadian Standards Association.

4) No overflow is to be installed and any access ports shall be made water tight with gaskets and mechanical fasteners.

When selecting a holding tank size an estimate of the daily water usage must be obtained. **Table 4.13** list some estimate flow rates for various activities. Please note **Table 4.13** contains only estimated flows. Actual measured flows would provide a more accurate estimate of water usage.

TABLE 4.13

HOLDING TANK SYSTEM SELECTION

Number of Bedrooms	1	2	3	4
Number of persons	2	4	6	8
* daily flows are on the type of fixtures in the home/cottage				
Days of Storage for the following Tank Sizes				
4500 l	15	×	×	×
9000 l	30	15	×	×
13500 l	45	22.5	15	11.3

* **Note:** these are flow estimates and actual usage will depend on personal conservation measures and the type/make of the fixtures installed in the home or cottage.

4.10.1 Typical Requirements of a Holding Tank System

- an audible alarm shall be installed in the building and shall sound when approximately 25% of the available storage remains. The high level could be set to shut off the water supply.
- copy of the pumping contract from a licensed septic tank cleaner shall be provided with the supporting information.
- the typical separation distances apply.
- other site specific conditions that may apply.

4.11 PIT AND VAULT PRIVY SELECTION

4.11.1 Introduction

The use of privies and non-water carrying systems are usually for seasonal dwellings with usage.

Privies and non-water carrying systems do not dispose of the greywater or household wastes other than toilet wastes and are not a complete disposal means even for the toilet wastes. Included in non-water carrying systems are the privy, electric or gas incinerating toilets, humus

or composting toilets and chemical toilets. Problems such as odours, maintenance and flies have been reported with privies and non-water carrying disposal systems .

Considering the need to dispose of greywater and to allow future conversion to a water carried system, the Department does not approve a lot for new construction unless it is suitable for a septic tank disposal system, even when a privy or a non water-carried system is proposed. If the lot is recommended and an approval issued, the homeowner can install a privy or a non-water carried system if he/she wishes.

Typical arrangement of privies are shown in **Figures 4.l and 4.M.**

- These systems are defined in the *"On-site Sewage Disposal System Regulations"* as pit privy or vault privy.
- The separation distances outlined in the Regulations shall apply,
- A privy shall consist of an enclosed structure that shall be constructed of strong durable weatherproof materials **(see figures 4.L and 4.M)** ;

4.11.2 Pit Privy

A pit privy should be constructed as follows **(Figure 4.L)**:

- the bottom of the pit shall be a minimum of 1.0 metres above the high ground water table;
- the sides of the pit shall be reinforced so as to prevent the collapse of the walls; and
- the surface of the ground in the area surrounding the pit shall be graded such that surface drainage is diverted away from the pit.

4.11.3 Vault Privy

A vault privy should be constructed as follows **(Figure 4.M)**;

- the vault, tank or structure which is to be used for the holding or storage of sewage shall be watertight;
- the vault shall have a locking cover that is easily accessible for the pumping of the sewage;
- the surface of the ground in the area surrounding the vault shall be graded such that surface drainage is diverted away from the vault; and

- when a high water table may be above the bottom of the selected vault, it shall be constructed to withstand highwater table conditions.(refer to the Section 3.1 for additional requirements)

4.12 OTHER APPROVED TECHNOLOGY

All other technology proposed for use in on site sewage disposal not covered in these Guidelines must have approval from the Nova Scotia Department of the Environment prior to installation. This includes methods of effluent treatment, distribution, and disposal.

Methods of effluent distribution will be sized based on the principles discussed in these Guidelines. Any additional Guidelines or policies developed by the Department for a particular technology must be followed as well as any requirements and installation instructions recommended by the manufacturer. In most, if not all, cases these technologies will simply replace distribution pipe and or crushed rock in the trench.

Based on the principles contained in these Guidelines, there is no evidence to support a reduction in the calculated size of the disposal field even if sewage is passing through a treatment device other than a septic tank. This is due to the hydraulic capacity of the soil only being able to accept an amount of liquid based on the soil and other site conditions. A septic tank is the least expensive form of treatment to use prior to an on site disposal field.

4.13 OTHER SYSTEMS

4.13.1 Greywater

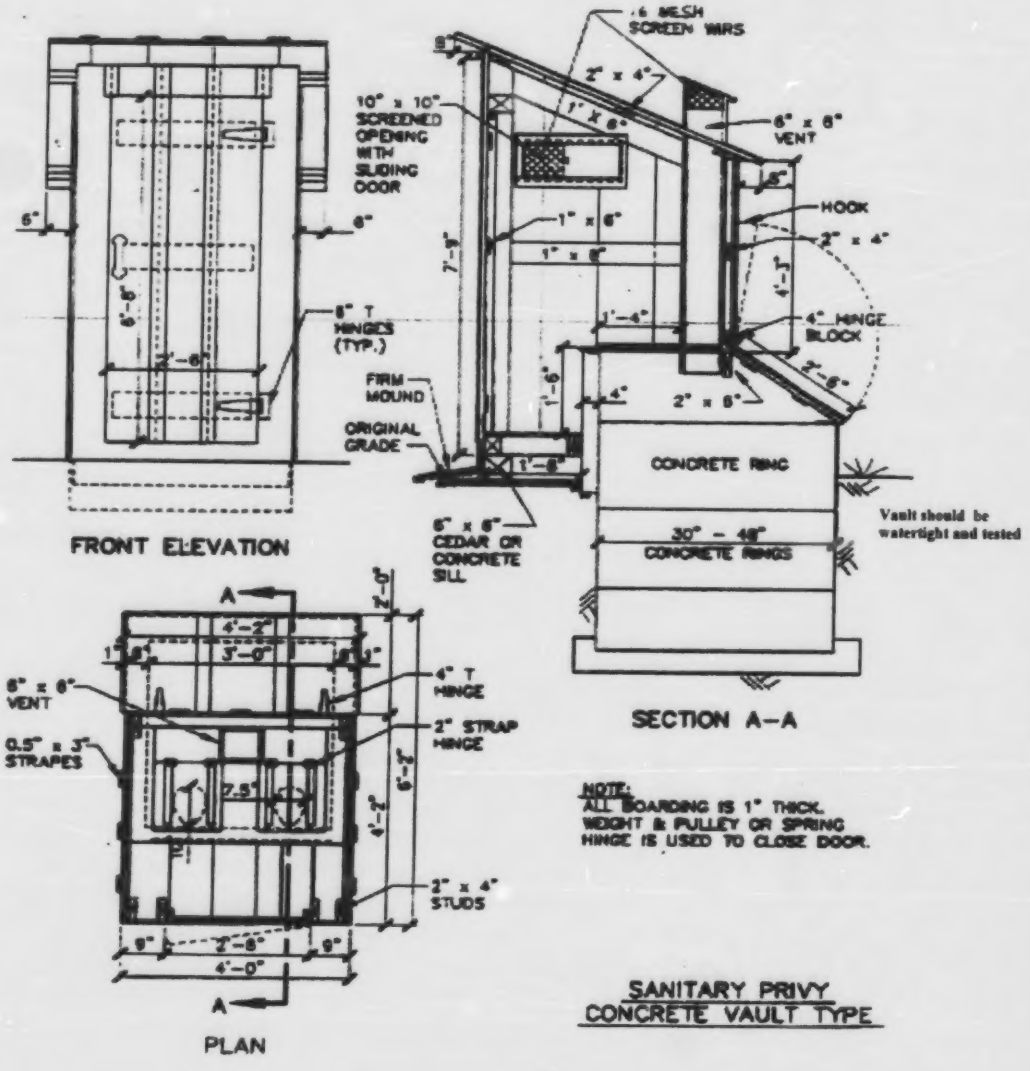
Greywater, which includes any household wastewater except that from toilets, can be a serious aesthetic and health problem if not disposed of in an acceptable manner.

In certain cases such as isolated hunting camps where the lot has been assessed as suitable for on-site sewage disposal and a privy or other suitable non-water carrying system is proposed, a system of some type is still required for greywater, i.e., sink wastes disposal. The details of the required system will be shown on the approval. It must be stressed that this type of system will not handle waste from washing machines, dishwashers, etc. but it is only intended for infrequent use of sinks and possibly showers. If the Department feels the installation of such a system could contaminate ground water or create a health or aesthetic problem, approval of such a system will not be recommended.

In the case of a full time residence which has a non-water carrying toilet, a standard on-site disposal system would be required for greywater. The size requirements for this type of system would be the minimum required for a single unit detached dwelling.

FIGURE 4 L

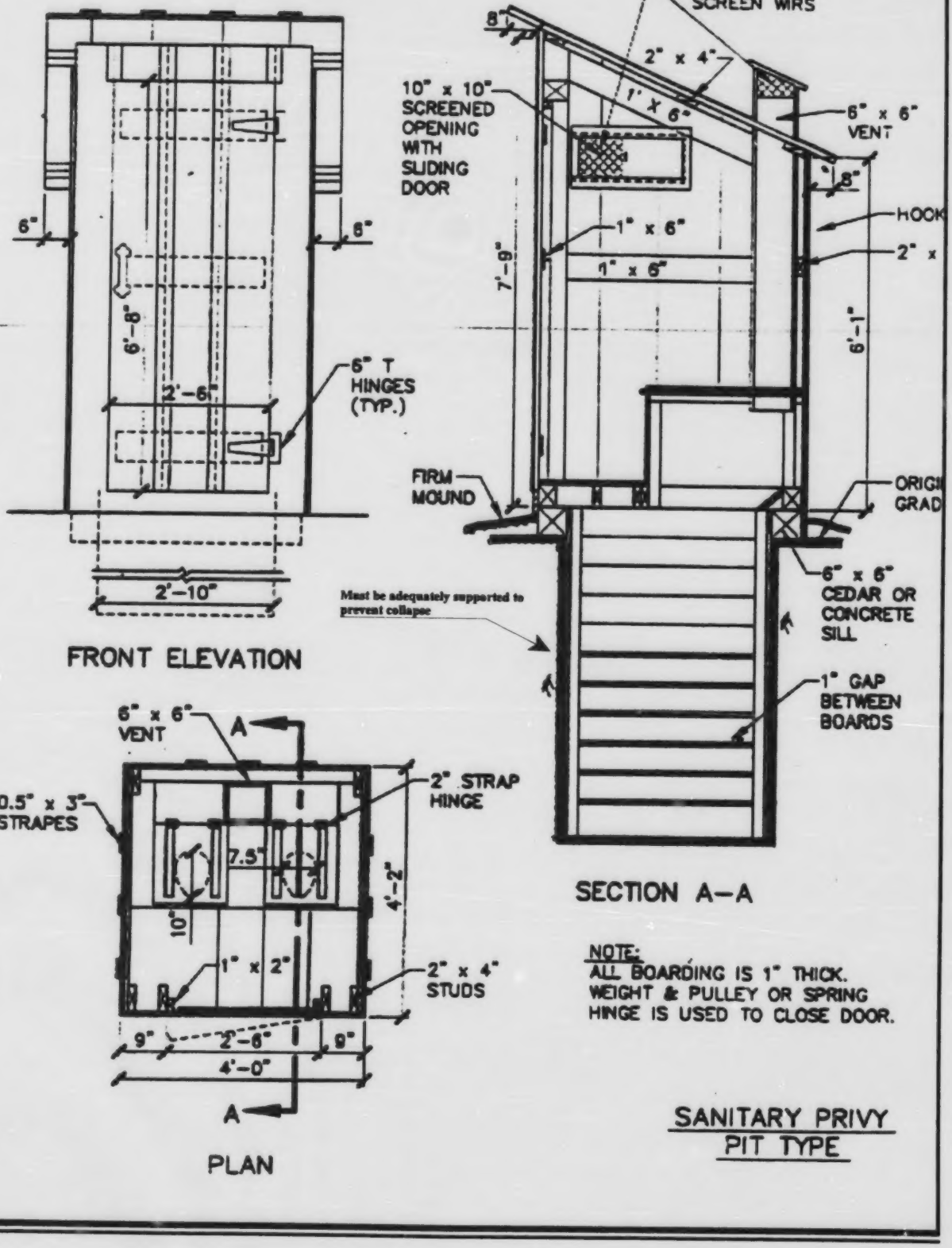
Vault Privy



SANITARY PRIVY
CONCRETE VAULT TYPE

FIGURE 4M

Pit Privy



NOTE:
ALL BOARDING IS 1" THICK.
WEIGHT & PULLEY OR SPRING HINGE IS USED TO CLOSE DOOR.

SANITARY PRIVY
PIT TYPE

SECTION 5

5. DISPOSAL FIELD DESIGN

5.1 GENERAL

These Guidelines are not intended to be a comprehensive design manual covering every aspect of on site sewage disposal system design. There are numerous references available regarding soil hydraulics and other aspects of on site sewage disposal that can be of value to the designer. It should be remembered that due to the variability of site conditions and the difficulty in estimating the long term effluent acceptance rate of a particular site that system design is not an exact science. In many cases experience with all aspects of on site sewage disposal including: lot assessment, system design, installation, maintenance, and the repair of malfunctions, is the most valuable tool the designer can have.

Section 4 of these Guidelines describes disposal fields that may be selected for single unit residential buildings with an average daily flow of up to 1500 L/day. Determination of design flows is discussed in Section 2 while Section 3 contains general information that can be used in the design of system components other than the disposal field.

This section addresses the design, from first principles, of systems intended for flows in excess of 1500 L/day or unusual site conditions which make the selection of a system from the Guidelines impossible. Most of the calculations involved can be easily carried out in a spreadsheet.

It should be noted that a QP2 can only "select" a system from these Guidelines and cannot use this section to "design" a system.

The general requirements of Sections 3, 4 and 6 apply to systems designed in accordance with this section.

The designer of a subsurface disposal system should take into account the possibility that wastewater flows, ground water levels, and soil and site conditions could exceed average values, and if not recognized in the design could contribute to system malfunction or failure.

5.2 DESIGN PRINCIPLES

On the majority of sites, design of disposal fields for soil conditions in Nova Scotia must consider the rate of lateral movement of effluent away from the system, because vertical movement is limited by ground water, bedrock, or soil with unacceptably low permeability.

Design considerations for both vertical and lateral movement of effluent are discussed in this

section.

Please note that calculations give theoretical system sizes based on given flow rates. Appropriate safety factors should be applied based on issues such as the level of confidence in the estimated sewage flows, soil permeability, other site features, the sensitivity of the situation to a potential future malfunction, plus financial considerations. .

5.2.1 Lateral Flow

The rate of lateral flow through soil is estimated by D'arcy's Law, which can be written as:

(1) $Q = L \times H \times I \times K$

where Q = average daily flow, m^3/sec
L = length of trench or bed, m.
H = the depth of soil that will become saturated in order to move effluent in a lateral direction, m.
I = the hydraulic gradient, m/m (usually considered to be equal to the slope of the ground surface at the location of the disposal field,)
K = permeability of the soil through which the flow moves, m/sec. This value depends on soil conditions including texture, density, and structure which can be determined during the site assessment described in Section 2. **Table 2.1** lists approximate ranges of permeabilities, for different soil types. For large disposal systems soil permeability should be measured in-situ and all site conditions considered to estimate a value for K.

Equation (1) can be rearranged to solve for L which gives:

$$L(m) = \frac{Q(m^3/sec)}{K(m/sec) \times I \times H(m)}$$

For convenience the units of Q can be converted to average daily flow in litres per day. This equation becomes:

(2) $$L(m) = \frac{Q(L/day)}{8.64 \times 10^7 \times K(m/sec) \times I\ (m/m) \times H(m)}$$

Once the design flow has been calculated and the site assessment is completed, all values are know except for L which can then be calculated.

TABLE 2.1

A GUIDE TO APPROXIMATE SOIL PERMEABILITY
(See Notes Following this Table)

SOIL TYPE	PERMEABILITY (m/sec) x 10^{-6}		
	PERMEABILITY CLASS	APPROXIMATE RANGE	APPROXIMATE AVERAGE
Rock, Clean Gravel	Unacceptably High	>800	
Medium to Course Sand	Acceptable	20 - 800	
Fine Sandy Gravel	Acceptable	20 - 80	50
Silty Sand	Acceptable	8 - 20	15
Sandy Silt	Acceptable	3 - 8	5
Clayey Silt	Unacceptably Low	0.8 - 3	1.5
Silty Clay	Unacceptably Low	0.2 - 0.8	0.5
Clay	Unacceptably Low	<0.8	

NOTE:

- Because of the wide range in permeabilities for sand, it is not appropriate to use an average permeability. Unless the permeability of the material is measured in situ, the lowest permeability, 20 x 10^{-6} m/sec ,should be used for system design

- Because of the low permeability of silty clays and clays the assumptions made regarding the permeability of the clogging mat for more permeable soils may not apply for these soils with low permeability. This combined with the effects of natural precipitation may result in lower effective permeabilities down slope of systems in these soils. Considering these points it is usually not appropriate to design area, trench or C1 type systems for these soils even if the theoretical calculated size can be fit on the lot.

- These soil types are based on texture, the relative content of rock, sand, silt, and clay. It is extremely difficult to accurately determine the long term acceptance rate of soil particularly when basing it only on soil texture. Other factors such as soil density, particle gradation, and soil structure combine to give different permeabilities to soils with

similar textures. Unless the permeability is established by in- situ measurement, or the designer has extensive experience in soil assessment, it would be advisable to use the lowest permeability in the range given for each soil type.

5.2.2 Vertical Flow

After several months of operation a disposal field will develop a clogging mat that consists mainly of organic debris and of micro-organisms that feed on and digest the organic material.

The clogging mat has a low permeability, which is much lower if it forms in finer textured soils. The permeability of a developed clogging mat is usually the limiting factor in the long term vertical flow rate.

The systems described here assume that filter sand, with a minimum depth of 75 mm, is placed below the gravel in the disposal system. When the clogging mat forms in this material it is expected that the permeability of the clogging mat will be maximized and its hydraulic resistance reduced. The hydraulic resistance is expressed in terms of the loading rate, which is assumed to be 33 (L/day)/m^2 of distribution trench for contour or mound type systems.

All disposal fields must include the 75 mm layer of imported filter sand . Table 5.1 specifies loading rates for area bed and multiple trench type systems.

The loading rates are used to determine the area of the bottom of the distribution trench in the system.

$$(3) \quad A = \frac{Q}{L_r}$$

where A = bottom area of distribution trench or bed, m^2
L_r = loading rate, (L/day)/m^2
Q = average daily hydraulic load, L/day.

The width of the trench will be:

$$(4) \quad W = \frac{Q}{L_r \times L}$$

where W = width of distribution trench or bed, m
L = length of distribution trench or bed, m
L_r = Loading rate L/Day/m^2

Minimum width of distribution trench width should not be less than 0.6m.

5.3 SLOPE LIMITATIONS

As stated in **Table 4.3** if the slope for a contour system exceeds 30 %, the system must be designed to assure the stability of the imported sand fill, and appropriate construction methods must be specified. Slopes less than 3% are not suitable for C1, C2 type fields. Slopes less than 5% are not suitable for a C3 field. Mound systems can be placed on sites with slopes less than 5% and area beds and multiple trench systems on sites with slopes of 3% or less.

5.4 DESIGN OF C1 SYSTEMS

Design of a C1 system requires the following information:

- average daily design flow (Section 2.6 & **Table 2.3** or from **Appendix F**)
- depth of each permeable soil type (Section 2.5)
- effective depth of unsaturated permeable soil (Section 4.4.3 **&Table 4.2**)
- available length of contour at the proposed location of the trench
- slope of hydraulic gradient.

The effective soil depth (H) for the C1 system is taken as the total depth of permeable soil minus the top 150 mm. This is to prevent soil saturation to ground surface which would result in soggy soil and the possible breakout of untreated effluent.

If there is only one soil type, simply insert the permeability of the soil (K) and the effective soil depth (H) into equation (2) and solve for (L).

For systems with multiple soil types a weighted average of the individual soil permeabilities considering their relative depths must be calculated and used in equation (2). In many cases it may be appropriate to simply use the lowest permeability of the soils encountered. The 150 mm

must be subtracted from the total depth of permeable soil to get effective soil depth (H).

The required length of C1 trench can then be calculated using equation (2). This calculation gives the theoretical length of trench required with out built in safety factors.

If the lot width permits, the trench length should be increased, to minimize the possibility of surface ponding, breakout during peak flow or adverse weather conditions.

Once the trench length has been determined from equation (2), the trench width can be determined from equation (4). The loading rate Lr will be 33 (L/day)/m^2.

There must be a least 1 m vertical separation between the bottom of the distribution trench and

ground water, bedrock, or soil with unacceptably high permeability.

A minimum length of a C1 system is 25 metres. If existing conditions on the lot preclude installation of a 25 metre long system a 15 metres long C1 may be installed if supported by calculations.

Generally it is not recommended to exceed linear loading rate of 60 litres/metre even if calculations indicate that shorter system is feasible.

C1 DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.

2. Calculate effective soil depth (E_d) :

$$H = T_d - 150mm$$

Where T_d - total permeable soil depth

3. Calculate weighted average horizontal soil permeability

$$K_{avg} = \frac{\sum_{1}^{n} K_n * H_n}{H}$$

Where: K_n - permeability of each soil layer
H_n - thickness of the respective soil layer
Remember to subtract 150mm from the thickness of the top (1st) permeable soil layer

NOTE: Instead of calculating a weighted average soil permeability it is advisable to use in the lowest permeability of permeable soil in the test pit and effective depth.

4. Calculate required system length:

$$L = \frac{Q}{8.64 * 10^{7} * H * I * K_{avg}}$$

Where : I - slope at the location of septic system.
Q - sewage flow in litres

For single family home, if calculated length is less than 25 metres use 25 metres as system length. Where existing conditions on the lot preclude installation of a 25 metres long disposal field , a 15 metre field may be installed if supported by calculations. The use of C1 greater than 60 metres in length is not recommended for single family home. It is not recommended to exceed linear loading rate of 60 litres/metre even if calculations indicate that shorter system is feasible.

5. Calculate width of the disposal field:

$$W = \frac{Q}{33 * L} \quad (m)$$

A minimum width should be 0.6 metre

6. Design disposal field cross section. **(See Figure 4.B)**

7. Select depth of the trench at the toe and calculate depth at heel using trench width (W) and slope (I).

$$C_h = W * I + C_t$$

Where C_h - depth of the disposal trench at heel (m)
Ct - selected depth of the disposal field at toe (m)

Check that depth to bedrock, water or soil with unacceptably high permeability at toe and heel is not less than 1 metre.

5.5 DESIGN OF C2 SYSTEMS

A C2 system, described in Section 4.6, transports effluent laterally in the sub-surface soil, and where the hydraulic capacity of the subsoil is inadequate, carries the remaining effluent in a layer of imported sand fill above the original ground surface.

The weighted average of flow that can be carried by the subsurface soil can be calculated as discussed above for a C1. However, where a C2 is being designed, the entire depth of permeable soil from ground surface can be used.

If all flow will be handled by the natural soil but the calculated depth of soil saturation will be closer than 150 mm to ground surface, a standard C2 can be used (**Figure 4.C**). In this case the pipe is installed with the invert slightly above the downslope lip of the trench. The imported sand fill buffer is placed for frost protection and to insure down slope of the trench does not become soggy and effluent does not come to surface before treatment takes place.

If the natural soil will not carry all the effluent, then a raised C2 may be considered. In a raised C2 some of the effluent will pass through the imported sand buffer.

Required length of the system can be calculated from the following equation:

$$(5)\quad L = \frac{Q}{8.64 * 10^7 * I * (K_{avg} * H_{Soil} + K_{fill} * D_{Sat})} \quad (m)$$

Where: Q - sewage flow in litres/day
I - slope in m/m
K_{avg} - weighted average soil permeability (m/s)
H_{Soil} - total depth of the permeable soil (not effective depth!) (m)
K_{fill} - permeability of imported sand fill (m/s)
D_{Sat} - saturation depth in fill (m)
NOTE: It is advisable to use in the calculations the lowest permeability of permeable soil in the test pit instead of K_{avg} to provide a safety factor.

A minimum length of a C2 system for a single family home is 25 metres. If existing conditions on the lot preclude installation of a 25 metre long system a 15 metres long C2 may be installed if supported by calculations. If the designed system is longer than 60 metres the use of a C2 for single family home is not recommended.

Generally it is not recommended to exceed linear loading rate of 60 litres/metre, even if calculations indicate that shorter system is feasible. A saturation depth in imported sand fill should be kept around 0.05m and generally not exceed 0.1m. There should be approximately 0.3m of fill above maximum saturation level in fill.

The length should be greater than the calculated value (L) if the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or high ground water conditions. If the length is increased, the width of the trench can be reduced.

After the length of the disposal field has been established, the width can be calculated from the equation (4) using loading rate of 33L/d/m^2:

$$(4)\quad W = \frac{Q}{33 * L}$$

A minimum width should be 0.6 metre

Where ground water, bedrock, or soil with unacceptably high permeability occur under a C2 system, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the distribution trench and the ground water, rock, or soil with unacceptably high permeability.

The width of the down slope buffer for a C2 system shall be at least 5 m.

C2 DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.
2. Calculate weighted average horizontal soil permeability

$$K_{avg} = \frac{\sum_{1}^{n} K_n * H_n}{H_{soil}}$$

Where: K_n - permeability of each soil layer
H_n - thickness of the respective soil layer
H_{soil} - total permeable soil depth

NOTE: Instead of calculating a weighted average soil permeability it is advisable to use in calculations the lowest permeability of permeable soil in the test pit and effective depth.

3. Calculate required system length:

$$L = \frac{Q}{8.64 * 10^7 * I * (K_{avg} * H_{Soil} + K_{fill} * D_{Sat})}$$

For single family home, if calculated length is less than 25 metres use 25 metres as system length. Where existing conditions on the lot preclude installation of a 25 metres long disposal field , a 15 metre field may be installed if supported by calculations. If length of the system is more than 60 metres use of C2 is not recommended for single family home. It is not recommended to exceed linear loading rate of 60 litres/metre.

4. Calculate width of the disposal trench:

$$W = \frac{Q}{33 * L}$$

A minimum width should be 0.6 metre

5. Design disposal field cross section.(see **Figure 4.C** and **4.D**)

6. Select depth of the trench at the toe and calculate depth at heel using trench width (W) and slope (I).

$$C_h = W * I + C_t$$

Where C_h - depth of the disposal trench at heel (m)
Ct - selected depth of the disposal trench at toe (m)
I - slope

Check that depth to bedrock, water or too permeable soil layer at toe and heel is not less than 1 metre, decrease depth at toe or design C3 if necessary.

5.6 DESIGN OF C3 SYSTEMS

A C3 system, described in Section 4.7, transports effluent vertically and then laterally in a layer of imported sand fill above the original ground surface. A C3 allows effluent to be treated as it passes vertically through the imported sand fill before it reaches ground water, bedrock, or soil with unacceptably high permeability.

The depth of imported sand fill saturation required to carry the flow can be calculated from the following equation:

$$(6)\ D_{Sat} = \frac{Q}{8.64 * 10^{7} * K^{fill} * I * L}$$

K^{fill} - permeability of imported sand fill in m/sec
I - Slope in m/m
L - C3 length in m
D^{sat} - fill saturation in m
Q - flow in L

There shall be approximately 300 mm of fill above maximum saturation level in imported sand fill. Saturation depth in fill should not exceed 0.1m. There shall be a minimum of 600 mm below the distribution trench. The depth of the buffer should normally have a minimum depth of 300 mm at a distance of 5m..

In the design of a C3 system the linear loading rate is *40* to 60 L/day per m. This is to avoid excessive seepage at the toe of the system in wet periods of the year. The length should be as great as the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or high ground water conditions. If the length is increased, the width of the trench can be reduced.

Where ground water, rock, or soil with unacceptably high permeability occur under a C3 system, the depth of imported sand fill must be enough to provide a 1 m vertical separation between the bottom of the gravel and the ground water, rock, or soil with unacceptably high permeability.

Once the trench length has been determined width can be calculated from equation (4).

The minimum width of the distribution trench shall be 0.6 metres.

The minimum width of the downslope buffer shall be 5 metres. If there is less than 150 mm of available soil, a 150mm high and 7m wide permeable soil mantle should be added after the downslope buffer. (See **Figure 4.E)**

C3 DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.

2. Calculate disposal trench length from the following equation:

$$L = \frac{Q}{R_{linear}}$$

Where: R_{linear} - linear loading rate in liters/day/m of disposal field (40 to 60 litres/day/m)
Recommended R_{linear} is **40 l/d/m**
For single family home, if calculated length is less than 25 metres use 25 metres as system length. Where existing conditions on the lot preclude installation of a 25 metres long disposal field , a 15 metre trench may be installed if supported by calculations. It is not recommended to exceed linear loading rate of 60 litres/metres/day.

3. Check saturation level in fill using equation (6), If the saturation level exceeds 0.1m you should increase length of the system to decrease saturation, or use more permeable fill (within acceptable permeability range).

4. Minimum depth of imported sand fill under the pipe must be 600mm.

5. The minimum depth of imported sand fill at the edge of the 5m buffer is 300m.

6. Calculate width of the disposal field:

$$W = \frac{Q}{33 * L}$$

A minimum width should be 0.6 metre

7. Design disposal field cross section.

8. Specify downslope width of buffer of 5 metres or more, and upslope width of buffer of 1 metre or more (see standard cross sections in **Figure 4E**.) If depth of permeable soil is less than 150 mm downslope buffer must be followed by a 150 mm thick and 7 metres wide mantle, in addition to the normal 5 m buffer. Refer to **Table 4.9** for systems with lengths less than 38 for hole spacing requirements. For systems that have a trench length greater than 38m and must be designed, there is a program available at *Dal. Tech.* that was developed by *The Centre for Water Resource Studies*.
9. Design pressure distribution system.
Check if separation to groundwater, bedrock or too permeable soil , at toe and heel is not less than 1 metre.

5.7 DESIGN OF MOUND SYSTEMS

Design of a mound system assumes that

- effluent will move vertically into the imported sand fill below the trench
- the basal area of the system is large enough to allow the effluent to enter the soil below the system
- effluent that emerges at the buffer toe is adequately treated (see Section 4.8).

In design of a mound system the minimum value of L should be based on a load of 40 to 60 L/day per m of trench and the total design flow, to avoid excessive seepage at the toe of the system in wet periods of the year. The length should be as great as the width of the lot will permit, to minimize the possibility of surface ponding or breakout during peak flow or high ground water conditions. If the length is increased, the width of the trench can be reduced.

The basal area of the mound should be based on a hydraulic load not greater than 10 (L/day)/m^2, to maximize vertical flow into the soil below the system. If there is a slope on the lot the up slope buffer can be one-half the width of the down slope buffer. On a flat lot the up slope and down slope buffers should be of equal width.

MOUND SYSTEM DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F.**
2. Calculate disposal trench length from the following equation:

$$L = \frac{Q}{R_{linear}}$$

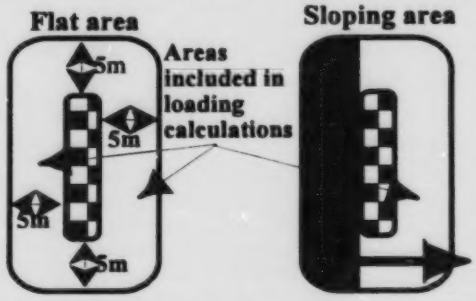
Where: R_{linear} - linear loading rate in litres/day/m of disposal field (40 to 60 litres/day/m)
Recommended R_{linear} is **40 l/d/m**
For single family home, if calculated length is less than 25 metres use 25 metres as system length. Where existing conditions on the lot preclude installation of a 25 metres long disposal field , a 15 metres trench may be installed if supported by calculations. It is not recommended to exceed linear loading rate of 60 litres/metre/day.

3. Calculate width of the disposal field:

$$W = \frac{Q}{33 * L}$$

A minimum width should be 0.6 metre

4. Design disposal trench cross section.
5. Specify buffer width each way of 5 metres or more. If there is less than 150 mm of permeable soil specify buffer width each way of 5 metres or more and a 150 mm thick imported sand fill mantle 3.5 metres wide. See cross section **Figure 4G.**



6.Calculate hydraulic load on basal area. On flat lots use entire perimeter of the mound. On sloping sites use only downslope portion of the mound as shown on above sketch. Increase buffer if basal loading exceeds 10 l/day/sq.m.
7.Design disposal bed cross section
8.Design or select (up to 38 m of pipe length use table 4.9) pressure distribution system

Check that depth to groundwater, bedrock or too permeable soil is more than 1 m.
Check that depth to restrictive layer at toe and heel is not less than 1 metre.

5.8 DESIGN OF AREA BED AND MULTIPLE TRENCH SYSTEMS

5.8.1 General

The use of area or multiple trench systems is generally only acceptable where there is deep permeable soil and little slope on the lot. Design of an area bed or multiple trench systems assumes that effluent will move vertically downward from the system into and through the subsurface soil. The design is intended to make the area of the bed large enough to insure that the hydraulic capacity of the soil can accommodate the expected flow from the system. Designs are based on empirical relationships that define the hydraulic capacity of each system. As discussed in Section 4.9, to use an fully trenched area bed or multiple trench system there should be at least 1.3 metres of permeable soil at the location of the system. Multiple Trench systems must have a minimum excavation of 150 mm.

Designs of these systems should aim to maximize the length of the system along the contour of the site. A long narrow bed will avoid concentrating the flow in the centre of the bed area and reduce the amount of water mounding under the system. Generally length to width ratio should be 3 or more to decrease effluent mounding. Mounding will be greater in soils with lower permeabilities due to the fact that a higher hydraulic gradient must be developed to cause the effluent to flow away from under the trench. As a general guide, the height of mounding should be calculated to make sure that effluent will not mound into the bed and result in a malfunction on systems. There are several methods of calculating this mounding height including an easy to use program developed by *The Centre for Water Resource Studies* at *Dal.Tech.*.

Area and trench type systems should have 75 mm filter sand in the bottom of the excavation to maximize permeability of the clogging mat. All other requirements covered in Sections 2 and 4 dealing with suitable site conditions to select an area or trench system also apply when these types of systems are being designed.

5.8.2 Area Bed Systems

Table 5.1 lists maximum hydraulic loading rates for area beds. These rates are based on the permeable soil type immediately below the system.

An area bed system can be designed using the following equations.

(3) $$A = \frac{Q}{Lr}$$

where:

	A	=	area of bed, m^2	
	Lr	=	hydraulic loading rate for soil below system **(Table 5.1)**	(L/day) /m^2
	Q	=	average daily design flow, L/day.	

(7) $\frac{L}{W} = 3 \text{ (or more)}$

(8) $L = \frac{A}{W}$

where:
L = Length of bed along contour, m (make as long as practical)
A = area of bed from equation (6), m^2
W = width of bed in down slope direction, (desirable max. 5 m)

AREA BED DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.
2. Calculate disposal bed area from equation (4) using loading rates from Table 5.1. Of the permeable soils below the bottom of the filter sand use the one with the lowest permeability in establishing appropriate loading rate.
3. Calculate disposal bed length and width using equations 5 and 6. Make sure that disposal bed is elongated as much as possible along contour line. Use length/width ratio of 3 or more. If possible width of the disposal bed should be 5 metres or less.
4. Design distribution network and disposal bed cross section
5. Select depth of the area bed trench. If there is less than 1300 mm (and 600 mm or more) of permeable soil use raised area bed disposal field. If there is more than 1300 mm of permeable soil use fully trenched system.
6. For large systems and in high groundwater level situations, perform mounding calculations. Make sure that there is 1 metre of vertical separation between bottom of the disposal bed and top of the estimated groundwater mound. Elongate or raise system if necessary.

TABLE 5.1

MAXIMUM HYDRAULIC LOADING RATES FOR AREA BEDS

Permeable Soil Type	Maximum Hydraulic Loading Rate (L/day)/ m^2
Fine Sandy Gravel/ med. to coarse sand	14
Silty Sand	11
Sandy Silt	9

NOTE: **Of the permeable soils below the bottom of the filter sand use the one with the lowest permeability in establishing appropriate loading rate.**

5.8.3 Multiple Trench Systems

Table 5.2 lists maximum hydraulic loading rates for multiple trench systems based on the permeable soil type immediately below the trench. A multiple trench system can be designed using the following equation:

(7) $$Lt = \frac{Q}{(Wt \times Lr)}$$

where:
- Lt = total length of trench and distribution pipe, m (make as long as practical along the slope)
- Lr = hydraulic loading rate (**Table 5.2**), (L/day)/m^2)
- Q = average daily design flow, L/day
- Wt = width of trench, m (normally 0.6 m).

TABLE 5.2

MAXIMUM HYDRAULIC LOADING RATES FOR MULTIPLE TRENCH SYSTEMS

Permeable Soil Type	Maximum Hydraulic Loading Rate (L/day) /m^2
Fine Sandy Gravel/ med. to coarse sand	25
Silty Sand	20
Sandy Silt	15

MULTIPLE TRENCH DESIGN SUMMARY:

1. Calculate sewage flows (Q) in litres according to **Appendix F**.

2. Calculate total length of disposal trench from equation (8) using loading rates from **Table 5.2.** Of the permeable soils below the bottom of the filter sand use the one with the lowest permeability in establishing appropriate loading rate.

3.Design number and length of the individual trenches. Make sure that disposal system is elongated as much as possible along contour line. Use length/width ratio of 3 or more. If possible width of the disposal system should be 5 metres or less.

4. Design disposal bed cross section

5. Select depth of the trench. If there is less than 750 mm of permeable soil Multiple Trench system should not be designed.

6. For large systems and in high groundwater level situations, perform mounding calculations. Make sure that there is 1 metre of vertical separation between bottom of the disposal trench and top of the estimated groundwater mound. Elongate or raise system if necessary.

5.9 SLOPING SAND FILTER

The sloping sand filter is intended to be used only for the upgrading of existing malfunctioning systems where there is not adequate land available to install an on-site sewage disposal system as described elsewhere in these Guidelines.

Discharge of treated effluent from the lower end of this system may occur particularly during periods of high precipitation. Low flush type toilets that use less than 1.5 Imp. gal/flush must be utilized as well as low flow shower heads and other water conservation devices. Care must be taken to assure that the soil under the filter does not contain sections of old disposal beds which could allow effluent to bypass the sand fill.

The sand used in a sloping sand filter is not the same as that used in other systems described in these Guidelines. It must have a permeability of $1x10^{-4}$ to $8x10^{-4}$ m/sec (also see Appendix B).

The length of the trench should be as long as the site will permit. It should not be less than 10 m per 1000 L/day of flow, which is based on the minimum sand permeability of $1x10^{-4}$ L/day. If adequate length is not available on the lot, it may be possible to design a system.

The width of the trench should be based on a loading rate of not more than 33 L/m^2 of trench bottom.

The depth of sand should be at least 450 mm.

If space on the lot permits, the width of the sand fill should be increased from the minimum of 5 m. The crushed rock and sand must be covered with geotextile, capped with imported sand fill and 15 to 20 cm of topsoil, and sodded.

Local conditions may require installation of disinfection system and/or liner.

Figure 5.A shows different types of the sloping sand filter.

Required length of the sand filter can be calculated from the equation (2) with a following changes:

$$L = \frac{Q}{8.64 * 10^7 * I * K_{fill} * D_{sat}}$$

Where :
- Q - sewage flow in (liters)
- L - length of the sand filter across the slope (m)
- K_{fill} - permeability of the imported sand fill (m/sec)
- D_{sat} - saturation of the sand (should not exceed 0.1m) (m)
- I - slope of the filter bottom (this is not necessarily the same as slope of the ground) (m/m)

NOTE: The minimum slope of the ground surface must be 3%.

5.10 SEPTIC TANK AND GREASE CHAMBER DESIGN SUMMARIES

SEPTIC TANK

For average daily flows up to 9000 l/day:

Vtank(1) = 2Q

Where: Q - average daily flow in litres
Vtank - tank volume in litres

For average daily flows 9000 l/day or more:

Vtank(2) = 9000 + Q

Where: Q - average daily flow in litres
Vtank - tank volume in litres

The minimum required septic tank size is 2800 L. Septic tank sizes larger than the required minimum may reduce problems and extend the life of an on-site system.

GREASE CHAMBER

For Restaurants:

$$V_{grease} = D * (HR/2) * GL * ST * LF$$

Where: D - number of seats in dinning area
HR - number of hours open per day
GL - gallons of wastewater per meal (2 or more)
ST - Storage capacity (normally 2)
LF - Loading factor depending on restaurant location

- 1.25 - central locations
- 1.0 - recreation areas
- 0.5 to 0.8 - other locations

For Cafeterias or Institutional kitchens:

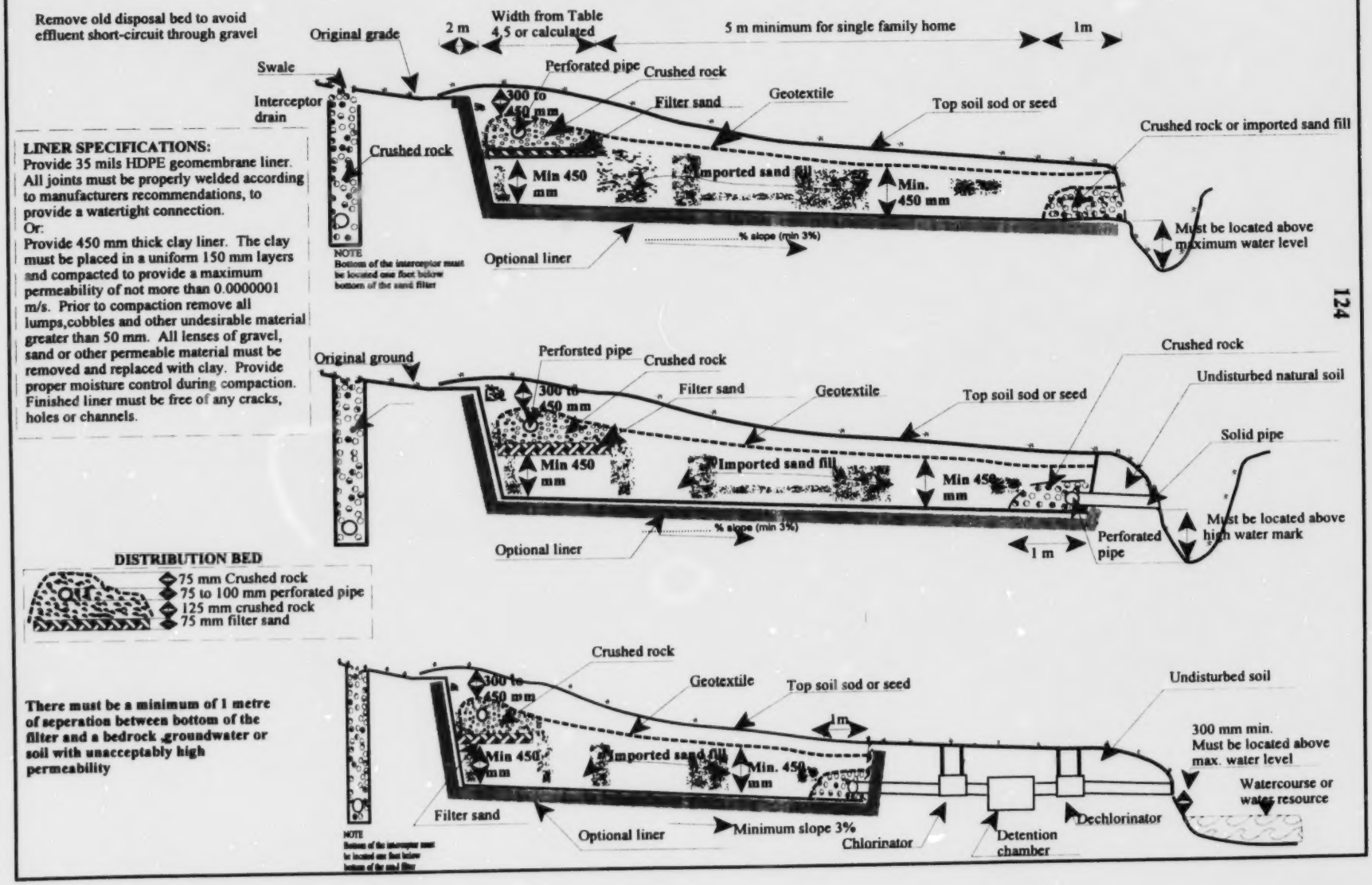
$$V_{grease} = M * GL * ST * LF$$

Where: M - Total number of meals served per day
GL - Gallons of wastewater per meal (2 or more)
ST - Storage capacity (normally 2)
LF - Loading factor

- 1.0 with dishwasher
- 0.5 without dishwasher

For details regarding septic tanks and grease chambers refer to Section 3.

FIGURE D1
SLOPING SAND FILTER


Remove old disposal bed to avoid effluent short-circuit through gravel
Original grade
2 m
Width from Table 4.5 or calculated
5 m minimum for single family home
1m
Swale
Perforated pipe
Crushed rock
Interceptor drain
300 to 450 mm
Filter sand
Geotextile
Top soil sod or seed
Crushed rock or imported sand fill
Crushed rock
Min 450 mm
Imported sand fill
Min. 450 mm
Must be located above maximum water level
% slope (min 3%)
Optional liner
NOTE
Bottom of the interceptor must be located one foot below bottom of the sand filter
LINER SPECIFICATIONS:
Provide 35 mils HDPE geomembrane liner. All joints must be properly welded according to manufacturers recommendations, to provide a watertight connection.
Or:
Provide 450 mm thick clay liner. The clay must be placed in a uniform 150 mm layers and compacted to provide a maximum permeability of not more than 0.0000001 m/s. Prior to compaction remove all lumps,cobbles and other undesirable material greater than 50 mm. All lenses of gravel, sand or other permeable material must be removed and replaced with clay. Provide proper moisture control during compaction. Finished liner must be free of any cracks, holes or channels.
Original ground
Perforsted pipe
Crushed rock
Undisturbed natural soil
300 to 450 mm
Filter sand
Geotextile
Top soil sod or seed
Solid pipe
Min 450 mm
Imported sand fill
Min 450 mm
% slope (min 3%)
Must be located above high water mark
Optional liner
1 m
Perforated pipe
DISTRIBUTION BED
75 mm Crushed rock
75 to 100 mm perforated pipe
125 mm crushed rock
75 mm filter sand
Crushed rock
Geotextile
Top soil sod or seed
Undisturbed soil
300 to 450 mm
1m
300 mm min. Must be located above max. water level
Min 450 mm
Imported sand fill
Min. 450 mm
Watercourse or water resource
Filter sand
Optional liner
Minimum slope 3%
Chlorinator
Detention chamber
Dechlorinator
NOTE
There must be a minimum of 1 metre of seperation between bottom of the filter and a bedrock ,groundwater or soil with unacceptably high permeability

SECTION 6

6. SYSTEM CONSTRUCTION

6.1 Introduction

Despite an excellent job being done of assessing the site and designing the disposal system, improper construction of a system can result in the premature failure of the system. Proper installation is one key to long term satisfactory performance. Failing systems cause many problems including: health and aesthetic concerns, wasted private and public funds, neighbourhood disputes, and the servicing of areas with collection and treatment systems where this should not be a priority. To reduce problems with system construction it is mandatory that anyone installing an on site system have a valid certificate of qualification.

6.2 Elevations

The elevation of the pipe in the field in relation to grade of the natural soil at the site will be given in the system details based on the conditions for the particular site. This pipe level will determine the elevation of the septic tank, and also the elevation at which the building sewer can leave the basement. This is critical on level sites and is often not considered by builders and home owners when planning basement levels and elevations of plumbing fixtures. Before the basement elevation or building sewer elevation are set, elevations of the system, the tank and the point at which the pipe leaves the basement wall should be calculated. A decision can then be made whether to:

1. set the basement floor above this level
2. have no plumbing in the basement
3. pump sewage to the septic tank from the basement or
4. pump all tank effluent to the disposal field.

It is likely that at times of snow melt or high rainfall, most soils in Nova Scotia will be saturated to ground surface. If the tank outlet is below this level, water will back up into the tank. Depending on the drop on the line from the house to the tank, sewage may back up into the house or, at the very least, the plumbing will be slow draining. Unfortunately this often results in the home owner having a relief trench or overflow of some type installed which results in a permanent discharge of raw sewage. To prevent this from happening, where ever possible the elevation of the bottom of the outlet from the septic tank should be above the elevation of natural soil at the disposal field. This is shown in **Figure 1.A**.

The finished grade on top and around the field must be sloped to divert surface water away from the field. Most soils will handle the effluent if this surface water is removed from the area. It is very important to sod or seed the area over and around the disposal field. The sod will prevent erosion and the established root zone will have a greater permeability than the soil below. This root zone

can play an important part in preventing effluent from reaching the ground surface before receiving adequate treatment.

6.3. Septic Tanks

Manufacturers' instructions must be followed for the installation of septic tanks.

Several types of commercially manufactured septic tanks are available. The most common is precast concrete. These tanks are sturdy, less expensive than some types, and do not require extra care in backfilling. The disadvantage is the weight and the fact that most precast tanks are made in two halves. The joint between the top and bottom half is extremely difficult to keep watertight and can result in leakage into or out of the tank. There have been reports of well contamination and sewage leaking into foundation drains resulting from leaking joints in tanks. If two piece tanks are used, care must be taken to assure the joints fit and are properly sealed. In installations where water table or bedrock is less than 1 m below the tank, or in gravel soil conditions, consideration should be given to the use of a one piece tank. Tanks must be tested for water tightness as per **Figure 3.A.**

A full tank weighs several thousand kilograms. Therefore, it is important to place it on solid, well compacted bedding material to avoid settlement. Tanks should not be placed on fill unless the material has been compacted in lifts of not more than 150 mm with a vibratory roller and must follow manufactures bedding requirements.

Plastic or fibreglass tanks have the advantage of being totally water tight and are much lighter than precast concrete tanks. The weight is a particular advantage when the tank must be installed in a confined area where reaching it with a boom truck is not possible. Backfilling plastic or fibreglass tanks require more care then concrete tanks. The **manufacturer's instructions for backfilling,** which may include the use of pea gravel, **must be followed.** Empty, reinforced plastic and fibreglass tanks have been known to pop out of the ground under high water table conditions. Therefore, these tanks must be tied down with weights, or to a concrete slab.

The homeowner may be reluctant to have the tank pumped at the required frequency unless there is an easy access. Consequently, it is required that, if the top of the tank is more than 600 mm below ground surface, an extension should be provided over the main access cover so that the excavation required to reach the tank is kept to a minimum. A riser must be water tight to avoid infiltration into the tank. There are products available such as reinforced plastic risers and covers sealed to a gasket poured into the tank cover. This type of construction should eliminate problems due to leakage. To avoid a tragedy that could result if a child removed a cover, any covers light enough to be moved by a child should be locked shut or covered with a few centimetres of topsoil and sod.

Shearing of the pipe at the tank inlet, outlet, or at the foundation is a common problem. These problems can be minimized with proper tank and pipe bedding and the use of SDR 35 or stronger pipe. Some contractors use flexible joints next to the foundation wall and the tank to avoid this problem. The foundation should always be backfilled before the sewer line is connected because

compacting the fill under the pipe is impossible once it is installed.

6.4. Soil Damage During Construction

Avoiding construction damage to the soil is an important consideration. The installer must be aware that this is a potential problem despite the type of system being installed. The objective should be to install the system, as designed, without reducing the permeability of the natural soils surrounding the field. Smearing and/or compaction of the soil interface is the most common and destructive damage that occurs during construction.

To maintain the permeability of the natural soil, the voids between individual soil particles and clusters of particles must not be destroyed. Preventing the smearing and compaction of the soil interface is essential, i.e. the top and sides of the natural soil in the excavation. Smearing will increase with higher clay content and higher moisture content in the soil. It occurs when machinery such as a dozer blade or backhoe bucket slides over this soil interface. The moisture acts like a lubricant allowing the clay particles to slide over each other sealing off the voids. Compaction from the wheels or tracks of machinery or footsteps increases the density of the soil and reduces the number and size of voids. Both compaction and smearing will reduce the soil permeability even if they take place in only a thin layer on the interface. Smearing can be reduced by working only when the soil moisture content is low. Unfortunately, this means that at certain times of the year, such as in spring, conditions may not be suitable for the installation of disposal systems, and construction should be delayed until conditions improve.

The type of machinery also influences the amount of damage that will take place. Excavation with a dozer tends to smear the interface more than the use of a backhoe bucket. The use of a dozer also causes more compaction of the soil interface because the machine is passing back and forth over it. The heavier the machine, the greater the pressure from the tracks and therefore the more compaction that can be expected. A light machine sitting to the side of the excavation will cause the least amount of damage. After the excavation is completed, the system should be finished as soon as possible. An exposed interface may be subject to compaction due to heavy rainfall, machinery, or people walking on it. To remove some damage due to smearing or compaction, it is recommended that the interface on all excavations be hand raked.

In most soils the effluent will move laterally away from the system in the down slope direction before it has time to go vertically into the subsoil. For this reason, it is important to keep machinery on the up slope side of the excavation. If machinery is allowed on the down slope, it may compact or rut the soil through which the effluent should pass. This may result in effluent breaking to the surface before it is adequately treated.

6.5. C1 and C2 Systems

When constructing these systems the following points should be remembered:

1. Effluent flows laterally down the slope away from the field.
2. A long narrow trench following the site contour is required.
3. Trench bottom and down slope lip are level.
4. Surface water and possibly perched water table must be diverted around the system.

The following procedure should be followed when installing C1 or C2 systems:

1. Check grades from the proposed pipe elevation in the disposal field back to the tank and check the elevation of the building sewer where it will exit the foundation. Be sure the slope on the pipe meets the minimum requirements.

2. Using an accurate tripod type level, set stakes at 3 to 5 metre intervals along the contour elevation that will be the lower lip of the trench. The length of the trench will be specified with the system design

3. If the area under a proposed C2 imported sand fill is covered in a heavy sod, this area should be tilled to help the passage of effluent into the natural soil. If the area contains trees, these should be cut at ground level and any large stumps or roots removed before tilling the area. Excavation to be back filled with imported sand fill., especially downslope of the trench.

4. The contour trench is then excavated following the stakes to the depth and width specified on the design. The bottom of the trench will be level in both width and length. The trench will be of constant depth throughout the length.

5. Hand rake the bottom and sides of the trench to remove smearing or compaction.

6. Determine where the solid line from the tank will enter the perforated pipe. Systems less than 30 metres in length can be end fed although centre feeding is preferred on all systems. A system greater then 30 metres must always be centre fed if it is not pressurized. If there is more than 60 metres of pipe, it must be pressurized

7. Spread a layer of filter sand, to the depth required for the system and not less than 75 mm, over the entire length and width of the trench.

8. Spread a minimum of 125 mm. of crushed rock on top of the sand. Note that the design of some systems may require more than the minimum of 125 mm. The rock should be graded as closely to the required pipe slope as possible, which will increase the crushed rock depth toward the effluent tee.

9. Place the perforated pipe on the rock and check to see that the slope on the pipe meets the specification of a drop of between 50 and 100 mm per 30 metres.

10. Cap the ends of the pipe. If the system is pressurized, a 13 mm. hole should be drilled in the top of the pipe 150 mm from the end cap to allow air to escape when the pump discharges.

11. Cover the pipe with 75 mm of crushed rock.

12. Cover the rock with geotextile (barrier material).

13. Carefully backfill the trench with excavated material providing it is not frozen and any rocks greater than 75 mm have been removed. The finished cover over the distribution pipe should be between 300 and 450 mm. If a C2 type system is installed, place imported sand fill buffer to the depth and width as shown on the approval.

14. Cover the entire area with topsoil and sod or seed the area immediately to allow a sod and root zone to be established as quickly as possible.

15. Wherever possible all heavy equipment and excavated material should be kept on the up slope side of the trench to avoid compaction of soil down slope of the system.

6.6. C3 Systems

The following procedure should be followed when installing C3 systems:

1. As all C3 disposal fields are pressurized to provide even distribution, the elevation of the tank and building sewers are not usually as critical as with gravity fed systems. However, the proposed location of tank and pump chamber should be established to make sure all components of the system will fit together.

2. Use an accurate tripod type level to place stakes along the contour line where the toe of the disposal trench will be located. Stakes marking the toe of the imported sand fill can then be set at the proper distance from the trench stakes.

3. If the area under the proposed C3 imported sand fill is covered in heavy sod, this area should be tilled to help the passage of effluent into the natural soil. If the area contains trees, these should be cut at ground level and any large stumps or roots removed before tilling the area.

4. Place the amount of imported sand fill shown on the design.

5. Excavate a trench into the imported sand fill to the width and depth shown on the design. The trench bottom should be level along both its width and length.

6. Spread a layer of filter sand to the depth required for the system and not less than 75 mm, over the entire length and width of the trench. If the imported sand fill meets the specification for filter sand, the filter sand layer is not required.

7. Place the rock and pipe as was explained above for the C1 or C2 trench. Drill 13 mm holes in the top of the pipe 150 mm back from the end caps to allow air to escape when the pump discharges.

8. Cover the completed rock trench with geotextile (barrier material).

9. Carefully cover the entire system with topsoil suitable for establishing a healthy sod layer.. The finished cover over the distribution pipe should be between 300 and 450 mm.

10. Sod or seed the disturbed area as soon as possible after completion of the system.

11. Where ever possible all heavy equipment and excavated material should be kept on the up slope side of the trench to avoid compaction of soil down slope of the system.

6.7 C3 Systems on Uneven Surface Lots

Where uneven surface lots, boulder fields or undulating wooded areas are encountered and conditions are such that a C2 would be normally used, the following criteria and techniques apply for construction of a modified C3 system:

1. Disturb the location of the field as little as possible (scarifying before imported sand fill placement may be necessary in grassy field areas, but is unnecessary in wooded areas).
2. Place the imported sand fill along the route of the contour filling hollows. Dress the imported sand fill so that the surface follows a contour (some boulders may protrude through).
3. Place filter sand, the bottom of the filter sand is to follow the contour.
4. Place crushed rock; the bottom of the crushed rock is to follow a contour.
5. Lay the distribution pipe level (the system will be pressurized).
6. Cover the pipe with 75 mm crushed rock.
7. Cover the crushed rock with geotextile (barrier material).
8. Cover with imported sand fill. (Refer to **Section 3.3.2** for specification.)
9. Landscape (soil and sod).

NOTE: For "humpy" ground such as old forest floor caused by rotten trees and stumps, it may be possible to create contour by levelling off some of the tops of the humps while minimizing the disturbance to the area where the buffer will go.

6.8 Mound Systems

The following procedure should be followed when constructing a mound system:

1. As all mounds are pressurized to provide even distribution, the elevation of the tank and building sewers are not usually as critical as with gravity fed systems. However, the proposed location of tank and pump chamber should be established to make sure all components of the system will fit together.

2. Locate the mound by placing stakes at the toe of the imported sand fill at the disposal trench location.

3. If the area under the proposed mound is covered in heavy sod, the area should be tilled to help the passage of effluent into the natural soil. If the area contains trees, these should be cut at ground level and any large stumps or roots removed before tilling the entire area.

4. Place the amount of imported sand fill shown on the design. Bring the sand up to the level of the top of the proposed trench.

5. Excavate the trench into the sand to the width and depth shown on the design. The trench bottom should be level in both width and length.

6. Spread a layer of filter sand to the depth required for the system and not less than 75 mm, over the entire length and width of the trench. If the imported sand fill meets the specification for filter sand, the filter sand layer is not required.

7. Place the rock and pipe as was explained above for the C1 or C2 trench. Drill 10 mm holes in the top of the pipe near the end caps to allow air to escape when the pump discharges.

8. Cover the completed rock trench with geotextile (barrier material).

9. Carefully cover the entire system with topsoil suitable for establishing a healthy sod layer.. The finished cover over the distribution pipe should be between 300 and 450 mm.

10. Sod or seed the disturbed area as soon as possible after completion of the system

11. Where ever possible all heavy equipment and excavated material should be kept on the up slope side of the trench to avoid compaction of soil down slope of the system.

6.9 Area and Multiple Trench Systems

The construction of area and multiple trench systems follow similar procedures. The difference is that in an area bed, the entire field area is excavated whereas in a trench field individual trenches are dug.

The following procedure should be followed when constructing an area bed or trench field:

1. Check grades from proposed pipe elevation in the disposal field back to the tank and check the elevation of the building sewer where it will exit the foundation. Be sure the slope on the pipe meets the minimum requirements.

2. Place stakes to locate the trenches or sides of the area bed. Note that the long dimension of either type of system should run along the contour of the site, following the contour as closely as possible.

3. Excavate the area or trenches to the depth and width shown on the drawing/sketch.

4. Hand rake the bottom and sides of the excavation to remove smearing or compaction.

5. Spread a 75 mm layer of filter sand meeting the specification over the entire length and width of the trench.

6. Spread a minimum of 125 mm of crushed rock on top of the filter sand. The crushed rock should be graded as closely to the required pipe grade as possible. It may be necessary to add additional crushed rock in some areas in order to achieve the required slope on the distribution piping and still maintain the minimum 125mm under the piping.

7. Place the pipe on the crushed rock. The header is a solid pipe, while the footer and connecting laterals between the header and footer are perforated pipe.

8. The slope on the header and the laterals must meet the specified drop of between 50 and 100 mm per 30 metre, with the footer remaining level.

9. For area bed systems the distribution pipes shall be placed as shown on the drawing/sketch a maximum of 5 metres from the wall of the excavation.

10. The lateral pipes shall be equally spaced as shown on the drawing/sketch with the maximum spacing being 3.0 metres between each lateral.

11. Cap the ends of the pipe. If the system is pressurized, a 13 mm hole should be drilled in the top of the pipe near the end cap to allow air to escape when the pump discharges.

12. Cover the pipe with 75 mm of crushed rock.

13. Cover the rock with geotextile (barrier material).

14. Carefully backfill the trench with excavated material providing it is not frozen and any rocks greater than 75 mm have been removed.

15. Cover the entire area with topsoil and sod or seed the area immediately to allow a sod and root zone to be established as quickly as possible.

6.10 Sloping Sand Filters

The sloping sand filter is constructed in a similar manner to the C3 disposal field only the sand filter is located in an area excavated into the natural soil. These systems are only to be used for repairs to existing malfunctioning systems where a more conventional system cannot be located on the site.

The following procedure should be followed when constructing a sloping sand filter system:

1. Effluent must be able to discharge from the toe of the filter. To allow this, the filter usually discharges to a ditch or along the edge of a steep slope. This discharge level will dictate the required elevation of the pipe, tank (in a gravity fed system), and building sewer elevation as it leaves the foundation. Starting at the proposed elevation of the bottom of the excavation at the discharge side, work back and check proposed pipe elevation in the disposal field, the tank elevation, and the elevation of the building sewer where it will exit the foundation. Be sure slope on the pipe meets the minimum requirements.

2. Excavate the natural soil to the dimensions shown on the design. The bottom of the excavation must be level across its width and have a uniform slope, not less than 3%, as specified on the design, on the down slope side of the excavation.

3. If the sand filter is located in the same area as an existing system, remove any pipe or rock in the immediate area of the filter to prevent the possibility of effluent short-circuiting into the old field and breaking out without adequate treatment.

4. Place the amount of imported sand fill shown on the design. Bring the sand up to the level of the top of the proposed trench.

5. Excavate the trench into the sand to the width and depth shown on the design. The trench bottom should be level in both width and length.

6. Spread a layer of filter sand to the depth required for the system and not less than 75 mm, over the entire length and width of the trench. If the imported sand fill meets the specification for filter sand, the filter sand layer is not required.

7. Place the rock and pipe as was explained above for the C1 or C2 trench. If the system is to be pressurized, drill 13 mm holes in the top of the pipe near the end caps to allow air to escape when the pump discharges.

8. Cover the rock trench and top of the imported sand fill with geotextile before covering with topsoil and seeding or sodding. The seed or sod should cover the entire area to allow sod and root zone to establish as quickly as possible.

9. If the toe of the system is in a ditch where erosion is possible or near a shoreline the down slope side of the system should be covered with rock that will resist the action of the water.

10. If the filter is being installed at a very sensitive site and it is felt that effluent disinfection is required, a collection pipe and discharge line can be installed at the toe of the sand. If chlorination is used for disinfection than dechlorination may be required to prevent damage to aquatic life. This type of system with a piped point discharge cannot be considered on site sewage disposal but is rather treatment an as such may approvals other than approval to install an on site sewage disposal system.

6.11 Interceptors

When an interceptor is being installed, the following points should be observed:

1. Interceptor locations are specified in Section 3.6.

2. An interceptor should have a bottom uniform slope to allow flow of collected water.

3. Any excavation that passes between the disposal trench and the interceptor must be sealed with compacted clay material. (see **Figure 1.B)**

4. If the interceptor discharge must pass under the disposal system, this discharge pipe must be solid and the trench must be sealed by backfilling with compacted clay material. (see Section 3.6.1)

5. Where an interceptor trench is filled with crushed rock, the top of the rock should not be covered with topsoil or sod unless an interceptor swale is provided.

6. *Roof water drainage should not* be discharged into an interceptor. A solid drainage pipe carrying roof water may be located in the interceptor trench if it discharges down slope of the disposal field.

7. Traffic must be restricted to the up slope side of the disposal area during construction of an interceptor drain

8. The bottom of an interceptor should extend at least 150 mm below the bottom of the trench in the disposal field.

6.12 Pipe Protection

When installing a portion of the distribution across a driveway and/or shallow installation, the pipe shall be protected from vehicle and frost damage. The distribution pipe shall be placed inside a larger diameter pipe, for example corrugated steel pipe, to prevent vehicle damage. Frost protection can be achieved by placing 50/75 mm rigid insulation over the distribution pipe where sufficient cover does not exist (greater than 1.5 metres). The insulation should extend to the width of the trench and ~3 metres beyond the edges of the driveway.

SECTION 7

7.0 ON-SITE SEWAGE DISPOSAL SYSTEM REPAIR AND REHABILITATION

7.1 General

All repair or rehabilitation work carried out on an on-site system must have an approval from the Department of the Environment and must be carried out by a licensed installer. When the size of the lot permits, a replacement system selected or designed from Section 4 or 5 may be required. If the room available for a replacement system is very limited an option for *design* may be a sloping sand filter. It should be noted that in accordance with the Regulations, a Level II qualified person can only select a replacement system that meets all the requirements of the Regulations and Guidelines. If the replacement system cannot be selected, design of the system must be carried out by a Level I qualified person.

The remainder of this section is adapted from a report entitled *On-Site System Repair and Rehabilitation* prepared by the Centre for Water Resource Studies, Dal-Tech, Dalhousie University, Halifax.

7.2 Malfunction Causes

Some of the common reasons for system malfunction or failure are explained below.

7.2.1 Hydraulic Overload

Hydraulic overloading means that the household is using more water than the disposal field can dispose of. There can be numerous causes for hydraulic overload including:

- the addition of high water use fixtures such as hot tubs
- concentration of water use, example multiple laundry loads on one day
- population increase due to family size increase or parties
- water treatment backwash directed to system
- leaking plumbing fixtures
- surface water from roof, driveways, foundation drains directed to system
- overland or topographic related infiltration into the field
- the system design is too small to dispose of the anticipated flow.

7.2.2 Under Design / Poor Construction

Some on-site systems may be doomed to a limited lifetime of operation from the start due to improper design or construction. Causes of malfunctions of this type include:

- inadequately sized system for the flow or soil conditions

- system installed in a poor landscape position or in an area with a high groundwater table or flow restrictive surfaces which won't allow the escape of liquids from the lot
- installation in a area where the natural permeability of the soil has been destroyed due to being graded or cut and filled
- the use of improper or inferior materials
- construction during wet conditions leading to smearing and reduction of permeability on the infiltrative surfaces
- lack of grades or level which cause uneven distribution of effluent and overloading of a portion of the disposal field.

7.2.3 Physical Damage

Physical damage to an on-site system can result from:

- A loss of infiltrative capacity in the disposal field due to driving over the bed
- Paving or building or storage of objects on top of the field
- Tree roots.

7.2.4 Lack of maintenance

One of the most common reasons for system failure is a lack of maintenance. If a system is not regularly inspected some of the things that can go unnoticed are:

- Lack of regular pumping can result in scum and solids carry over into the disposal field and a possible permanent reduction of the soils infiltrative capacity
- Baffles may degrade and break also resulting in scum and sludge carry over to the disposal field
- Frost heave or uneven soil settling may result in uneven distribution within the disposal field and the subsequent overloading and damage to a portion of the field.

7.3 Trouble Shooting Procedure

The following is a trouble-shooting procedure for someone faced with a system malfunction. While the point of view of this section is directed to the homeowner it is expected an on-site professional will carry out any repair or investigative work. Also as noted above the first step in any repair procedure is to inform the Department of the Environment to see what advice they can provide and to make sure approval is obtained to carry out any necessary repairs.

STEP 1 Information

Gather as much information as you can about the system. If the homeowner has no written record of the system the first trouble shooting procedure should be to conduct an interview and gather information as listed in the form shown in Figure 7.A. A good practice for the homeowner is to keep

a file folder with a diagram of the system, which locates the position of the septic tank, the pump chamber if present, and the disposal field. In Nova Scotia, the local Department of the Environment may have a copy of the approval to construct a septic system which will have approximate locations, tank size, and disposal field type. The file folder should also contain the name and number of the local tank pumper and a service record for the system. The next time the tank is being serviced the exact location of the tank covers with reference to the corners of house should be measured and recorded.

STEP 2 Inside the House or Between House and Septic Tank

If the sewage is backing up into the house you may have a physical blockage somewhere in the household plumbing system. If you have a flush that won't work or a drain that refuses to empty, the place to start trouble shooting is at that appliance. A plunger may start the toilet running again or a drain trap cleaning may restart your sink and in this case your work is done. If you have access to the Internet and excellent resource documents all aspects of toilet function and repair at http://www.toiletology.com/.

If liquid is not leaving your house a good first step is to hire a professional plumber. Have the plumber check for a physical blockage in the house plumbing and check the pipe between the house and the septic tank. If something has been flushed down the toilet, like a rag or a diaper (or a bewildering array of children's toys), it may have become lodged in the pipe preventing liquid from moving out to the septic tank. Another common culprit is a combination of congealed grease and lint from the washing machine, blocking the pipe.

Frost heave and soil settling may have altered the original slope on the sewer line between the house ad the septic tank. It should have been installed with a slope of 1 to 2 percent so that the solids in the waste stream are carried along with the liquid. This pipe should also be checked to ensure it is still level all the way from the house to the tank. If it has low spots liquid will puddle and during the winter months may freeze and block the flow to the tank. If there are not blockages this far the problem may lie in the septic tank.

STEP 3 The Tank

A typical septic tank schematic is shown in **Figure 3.A** . Before investigating the tank here are some important things to note.

Number one, NEVER get in the tank. Part of the process of breaking down sewage produces odorless poison gases that can very quickly render you unconscious. More than one person has entered a pumped out tank to make a repair that turned out to be their last. The Department of Labour has strict requirements regarding the proper way to safely enter a confined space such as a septic tank.

Number two, the liquid in the tank should be treated with caution and respect. Sewage may contain disease causing bacteria, viruses or parasites which ca be transmitted to someone coming in contact

with the sewage.

The septic tank is watertight and designed to operate full of liquid. When 135 L come into the tank from a load of laundry, 135 L flow out to the disposal field. Because you have pulled the cover off and see that the tank is full does not mean you have a malfunctioning system. The tank is designed to have the outflow level approximately 75 mm below the inflow level. This gives a quick and easy check on the tank operation. If the distance between the bottom of the pipe coming from the house and the liquid level, not the scum level, is less than 75 mm, then either the septic tank outflow pipe, the disposal field pipe, or the disposal field are not draining properly. More about that later. One other possibility would be if ground water in the area of the system is high and is leaking into the tank or if the disposal field is not able to handle the volume of effluent.

Key trouble spots to examine in the tank are the inlet and outlet baffles or tees. If there is a blockage in the tank it will usually be at one or the other of these locations. Also, it is important to check that the tank still has baffles. In older metal tanks it is common for the baffles to deteriorate and fall into the tank. If your tank is in this condition it means that scum and solids have been allowed to exit to the disposal field which may have resulted in clogged soil pores.

If the difference between the inflow pipe and the liquid level is greater than 75 mm, then the liquid in the tank is finding its way out of the tank somewhere other than the pipe leading to the disposal field. A leak in the tank could be the result of a deteriorated portion of the tank. Most tanks in Nova Scotia are mid seam tanks. This means that the bottom half of the tank is lowered into place then a sealer is spread along the upper edge and the top half of the tank is lowered into place. This allows the installer to use a smaller boom truck to set the tank in place. If the liquid level in the tank is about half way down then this seam is most likely leaking.

The sludge level in the tank should be checked. This may help give some clues as to the condition of the disposal field. As the sludge level gets deeper, the flow of liquid through the tank is more likely to pick up and carry solids from the tank into the disposal field. If your tank is close to being full of sludge, solids may have been carried into the disposal field resulting in clogged pipes, soil pores or crushed rock .

Many tanks, but not all, will have a scum layer on the surface of the liquid. This is normally from 50-200 mm thick and can be quite solid looking.

If the system malfunction has not been located in the plumbing or the septic tank the next place to check is the disposal field.

STEP 4 The Field

The problems with the disposal field can be varied and involve overland water flow, subsurface water flow, household water use, or a clogging of the disposal systems pipes or soil pores. Some indication of the source of the problem can be determined from whether the malfunction is

continuous or periodic. If the failure is constant it has several potential sources:

- too much water going into the system (same as system undersized for flow)
- the distribution pipes, crushed rock or soil have become clogged
- the system has been damaged by landscaping construction (smearing), or heavy traffic

The disposal field is likely either a trench or large bed filled with a layer of gravel. A pipe with no holes runs from the septic tank and delivers effluent to the perforated pipes situated in the gravel.

A schematic of a typical field is shown in **Figure 1.A** . One cause of system failure can be that the perforations in the pipe have become blocked and flow to the gravel . If an end or a corner of the disposal field is exposed and the gravel is dry and clean with no standing liquid, it may be the pipes that are clogged. In this case an end of the pipe may be uncapped and the pipe cleaned with a high pressure jet washer by an on-site professional. Often this will unclog the pipe and or the perforations. This will not help much if the crushed rock or soil pores are plugged.

If there is a distribution device, such as a distribution box, pump, or siphon it should be checked to determine if effluent is being sent to all sections of the field evenly.

If a portion of the disposal field is exposed and it is found full of standing liquid then the soil below the system is either refusing to, or very slowly, accepting effluent. Soil clogging is usually the result of the development of a thick biological mat on the soil below the system. The soil pores become physically clogged with solid matter carried out of the tank, and the proliferation of biological growth in this layer. A clogging mat develops at the gravel soil boundary, to some extent, in all systems. If the disposal field has been undersized with respect to the flow from the house, or fed with high organic strength effluent, as from a garbage grinder, this mat may have become very thick and resistant to flow.

In many cases once the natural soil has become clogged it will remain clogged requiring either an entire or a partial new field. The addition of extra trench, if space is available, is one of the most common field repairs. In cases where no new area for a field is available the old field may be removed and replaced with a lateral sand filter. Details on the sloping sand filter are shown in Section 5.9.

The combination of having the disposal field pipe cleaned and the tank pumped, will give the field a rest. This, and a reduction in water use in the household, and preventing further solids migration to the disposal field with a septic tank effluent filter, may result in a slow re-establishment of a portion of the original capacity of the system.

Settling over the trenches may have caused long linear depressions along the trench which accumulate surface water and can contribute to hydraulic overloading.

The field may have become damaged through compaction from landscaping or traffic. The use of imported sand fill that does not meet the specifications may cause effluent to pond in the crushed rock field. The permeability of the imported sand fill can be checked and if it is too slow it must be removed and replaced with suitable material.

7.4 The Failure Analysis for Trouble Shooting Septic Systems (FACTSS)

There is a computer program available, called FACTSS that may help evaluate and track system failures.

The FACTS program is based on work completed in North Carolina on the development of a failure analysis chart reported in FACTSS:Failure Analysis Chart for Trouble Shooting Septic Systems (Adams, et al., 1998. ASAE;Proceedings of the 8th National Symposium on Individual and Small Community Sewage Systems).

The developers note that the flow chart was prepared in response to the need for a systematic method to evaluate the cause of failure for on-site systems and to identify repair solutions that are appropriate to correct the problems. The flowchart was developed for analyzing gravity distribution systems. It does not address systems that use advance pretreatment such as sand filters, peat filters, or pressure-dosed systems such as C3's or mounds. The chart was also developed primarily for typical residential systems. The program and chart are not aimed at the homeowner, instead it is expected that the primary audience will be either a private sector or government on-site professional who is faced with a failing system.

The flow chart guides the user through a process for trouble shooting a system and arriving at appropriate malfunction solutions. These steps include:

- determining the type of system
- determining the location of the malfunction
- determining the frequency and duration of the malfunction
- evaluating the water use in the home
- evaluating the site and soil conditions
- evaluating the functionality of the drain field and distribution system
- evaluating the likelihood of a biomat-induced malfunction
- summarizing the factors contributing to the failure
- developing and implementing appropriate repair options to solve the problem

Potential contributing factors to the system failure are considered "flags". When the failure analysis is complete the user will have identified a list of flags. In the computer program these potential causes have been listed in red text.

One of the first steps in the trouble shooting process is to gather as much information as possible concerning the system. The main screen of the program contains the Homeowner Information Form.

This information can be collected during the field assessment or during a telephone interview and ca be saved and recalled as a file. In the event that a large number of files are to be saved it is recommended that a consistent nomenclature be used to facilitate the search and retrieval process.

The flow chart developers strongly recommend that the most senor environmental health specialists work with repairs. A list of repair options is shown in the table below . It takes experience and judgement and openness to innovation to determine the correct course of action while protecting the public health and environment. Cost, appearance, feasibility, longevity and function are all criteria that the specialist and the homeowner must consider when designing a repair system. Particular water use characteristics or lifestyles of the users will influence the repair solution.

This flow sheet provides a logical and systematic approach to system repair. The developers believe that this will:

- increase the rate of success for repairing systems
- minimizes repeat trouble shooting on the same system by logically eliminating problem
- improves the ability of environmental health specialists and other trouble shooters to design effective repairs for failing systems
- redistributes field staff workload by improving their ability to logically trouble shoot a system in a timely manner
- provides a legally defensive approach to repair work efforts.

TABLE 7.1

REPAIR OPTIONS

Malfunction/Solution Option Table	
MALFUNCTION	SOLUTION OPTION
Leaking Plumbing Fixtures	Repair/replace fixture
Running faucets to prevent freezing of pipes	Insulate pipes/use heat tape
Dishwashers, jacuzzis, hot tubs, spas, excess laundry	Spread flow out over time using timed dosing with a pump tank; spread out laundry and dishwashing over the week, full loads only, use water saving machines, use off site facilities
Parties, visitors	Expand system; timed dose system; have septic tank pumped before arrival of guests
Water treatment system discharges to septic system	Remove discharge from septic system
Flow exceeds design	Use of water conservation; expand drain field; use of off-site laundry facilities
Surface water intrusion	Landscape to divert surface water away from system; fill depressions over system; collect and divert roof and gutter water.
Poor landscape position	Move system, divert ground and surface water away from system; fill depressions
Blockage in plumbing	Call plumber to remove blockage
Ground water entering system	Install drainage upslope of system and outlet drainage below system; install system above limiting horizon
Unsuitable soil conditions	Move system to a suitable area; install system above limiting horizon.
Short circuiting of effluent between trenches in drain field	Locate short circuit and correct
Biomat formation	Replace system; use alternating valve to rest sub-fields
Undersized drain field	Increase to proper size use water conservation to reduce flow into system
Unequal distribution from distribution device	Level device; adjust or install flow leveling device

Figure 7.A

ON-SITE SEWAGE DISPOSAL SYSTEM MALFUNCTIONING INSPECTION FORM

Owners Name:	**Date of Complaint:**
Address:	**Telephone:**
Subdivision:	**Lot #:**
Installer of System:	**Date System Installed:**
Approval #:	**Selector/ Designer of System:**
Date of Certificate of Installation:	

If there is no record of an approval being issued and it is obvious the existing system is using an outdated technology or is grossly undersized, skip to the comment section, otherwise, complete the following form where pertinent.

- LOT CATEGORY _____ FIELD TYPE _____ LENGTH/SIZE _____PRESSURIZED ___ _____
- SEPTIC TANK SIZE _____ NUMBER OF CHAMBERS _____ TYPE _____
- INTERCEPTOR DITCH/SWALE _____
- FILL USED _____ QUALITY _____ DEPTH _____ WIDTH _____LENGTH ___ ___

  PERMEABILITY _____ N/A _____
- TYPE OF PIPE_____ BARRIER MATERIAL _____ _____

DATE TANK PUMPED _____OTHER PREVIOUS PUMPED DATE(S) _____ _____

NATURE OF PROBLEM : BACK-UP _____ BREAKOUT _____ SLOW DRAINING _____
ODOUR _____ OTHER _____

PROBLEM FIRST OBSERVED: DATE: _____

LIST ANY SITE WORK DONE TO HOUSE SINCE OCCUPANCY, such as underground, underground roof drains, basement foundation drains, landscaping, etc: _____ _____
_____ _____

FREQUENCY OF PROBLEM: CONTINUOUS _____ OCCASIONAL _____

SEASONAL _____ AFTER RAINS _____

AFTER HEAVY USE _____ COLD PERIODS _____

OTHER _____

HAS A MALFUNCTION BEEN CORRECTED PREVIOUSLY?

HOUSEHOLD DISPOSAL PRACTICES: DIAPERS_____

CIGARETTES_____

HOUSEHOLD AND OTHER CHEMICALS_____

_____

TYPE(S)_____

WERE NEW FIXTURES ADDED SINCE THE SYSTEM WAS INSTALLED ?:_____

_____

TYPES_____

LIST PLUMBING FIXTURES such as spas, whirlpools etc, other than sinks, lavatories, baths/showers and toilets

_____

___

OBSERVED PROBLEMS:

- PIPE PROBLEM : BUILDING SEWER _____ EFFLUENT LINE _____ BED _____ N/A _____

  PIPE: BROKEN _____ SAGGED _____ CLOGGED _____ HOLES PLUGGED ____ N/A __

  ___

- CLOGGING MATERIAL: SOLID _____ GEL _____ SEMI-LIQUID _____ OTHER _____ N/A _

  ___

  COLOR OF CLOGGING MATERIAL: BLACK _____ GREY _____ OTHER _____ N/A _

  ___

- FLOODED BED _____ BREAK OUT _____

  EXTENT OF BREAK OUT _____

_

OTHER OBSERVATIONS

- TANK CONDITION _____ BAFFLES _____ LEAKING _____

  ___

  CONTENTS OF TANK: DEPTH OF SCUM LAYER _____ SCUM ABOVE BAFFLE _____

DEPTH OF SLUDGE LAYER _____ NEAR BASE OF BAFFLE _____

SCUM LAYER: SEMI-SOLID ____ GEL ____ LIQUID ____ COLOR _____

DEPTH TO TANK TOP_____ IS TOP BELOW HIGH WATER LEVEL?

- DEPTH OF DISPOSAL PIPES _____
- SURFACE DRAINAGE TOWARDS FIELD/TANK _____ ROOF DRAINAGE TOWARD FIELD/TANK _____
- DOES BED FOLLOW THE CONTOUR OF THE LOT? _____
- WHEN WAS SEEDING OR SODDING COMPLETED AFTER FINAL INSPECTION _____
- CONDITION OF INTERCEPTOR DITCHES _____ N/A ___

TRAFFIC OVER: TANK _____ BED _____ PIPES _____

WATER SUPPLY: MUNICIPAL _____ DRILLED WELL _____ DUG WELL

WATER QUALITY: HARDNESS _____ pH _____ IRON _____ MANGANESE _____

IN HOME WATER TREATMENT: SOFTENER _____ GREEN SAND FILTER ____ OTHER _____

BACKWASH WATER DISCHARGED TO _____

IS SEWAGE PUMPED INTO TANK ? YES _____ NO _____

WASHER: AUTOMATIC _____ MAKE _____ LINT TRAP _____ WASH DAY

NO. OF WASHES/WEEK _____

DISHWASHER _____ GARBAGE GRINDER _____ LARGE TUBS _____ HOT TUBS ____

AVERAGE DAILY WATER USAGE:_____

NUMBER OF HOUSING UNITS ON THE SYSTEM _____

NUMBER OF PEOPLE ON THE SYSTEM: NORMAL _____ PEAK _____

LEAKING PLUMBING FIXTURES? _____

COMMENTS: _____

_____

_____

BASED ON THE INFORMATION AVAILABLE, THE PROBABLE CAUSE OF THE MALFUNCTION:

CAN BE DETERMINED_____ CANNOT BE DETERMINED_____
(Provide details below)

DETAILS _____

_____

_____

_____ _____
COMPLETED BY DATE

All repair or rehabilitation work carried out on an on-site system must have an approval from the Department of the Environment and must be carried out by a licensed installer. A Level II qualified person can only **select** a replacement system that meets all the requirements of the Regulations and Guidelines. If the replacement system cannot be selected, **design** of the system must be carried out by a Level I qualified person. Refer to On-site Sewage Disposal System Interpetation Bulletin - *Replacing Malfunctioning Systems* and *The On-site Sewage Disposal Systems Technical Guidelines*.

APPENDIX A

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APPENDIX B

SIMPLIFIED FALLING-HEAD PERMEAMETER TEST FOR IMPORTED SAND FILL

APPENDIX B

SIMPLIFIED FALLING-HEAD PERMEAMETER TEST FOR IMPORTED SAND FILL

The permeameter consists of a clear plexiglass tube with one end covered by a fine mesh screen. The cylinder is stood in a low plastic container with a layer of filter fabric or fine screen at bottom to allow free exit of permeating water. The details and general arrangement of the apparatus are shown in Figure B1.

The sand to be tested shall be 100% saturated with water. Care should be taken not to wash out fines from the sand. Approximately 60 mm of the sand to be tested is placed in the cleaned cylinder and compacted by allowing the cylinder to fall 200 mm five times onto a piece of wood or a firm surface. (The piece of wood may be placed in a shallow box to contain splashes). More sand is added to the 105 mm mark and again compacted. The cylinder is then placed in the container and the sand flooded from the bottom up to drive out any air. After allowing the sand to drain excess water, the sample is again compacted by dropping 200 mm five times.

The cylinder is now returned to the container and flooded from the bottom up, then water is carefully poured into the top of the cylinder above the upper reference mark. The water level is now allowed to fall, noting the time in minutes that it takes to pass over the 50 mm gauge length. Measure the temperature of the water at the time of the test. Now refer to the **Figure B2** to determine the sand suitability for a septic system.

The test done on the sample taken from a stockpile or pit does not guarantee that all sand from that source is suitable for septic system. It must be confirmed by tests done on sand supplied to the site.

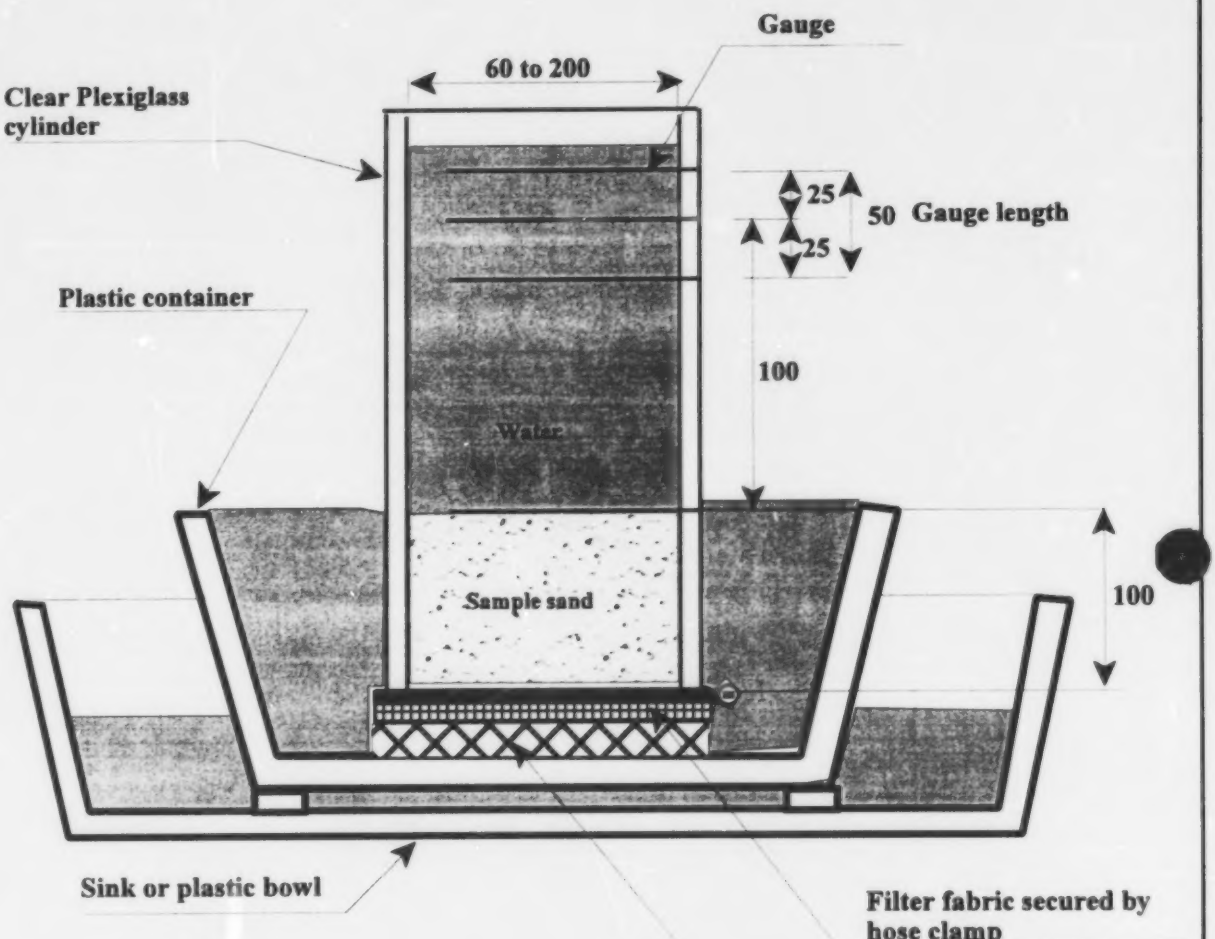
TEST:

1) Saturate the sand with water, avoiding ponding of the water on the top of the sample.
2) Add 60 mm (3 1/3") of the sand to cylinder and drop cylinder five times 200 mm onto a wooden block.
3) Add more sand to 110 mm (4 1/3") and drop again five times 200 mm.
4) Place cylinder into container with water. When the water surfaces over the sand, remove cylinder and allow water to drain. This will ensure saturation.
5) Compact sand again by dropping cylinder five times 200 mm.
6) Return cylinder to container with water. After the water surfaces carefully pour water into the top of the cylinder to a level above the upper reference mark.
7) Allow the water level to fall noting the time in minutes that it takes to pass over the 50 mm (2") gauge length.
8) Refer to Figure B2 to determine the suitability of the sand for a septic system.

FIGURE B1

FALLING HEAD PERMEAMETER APPARATUS

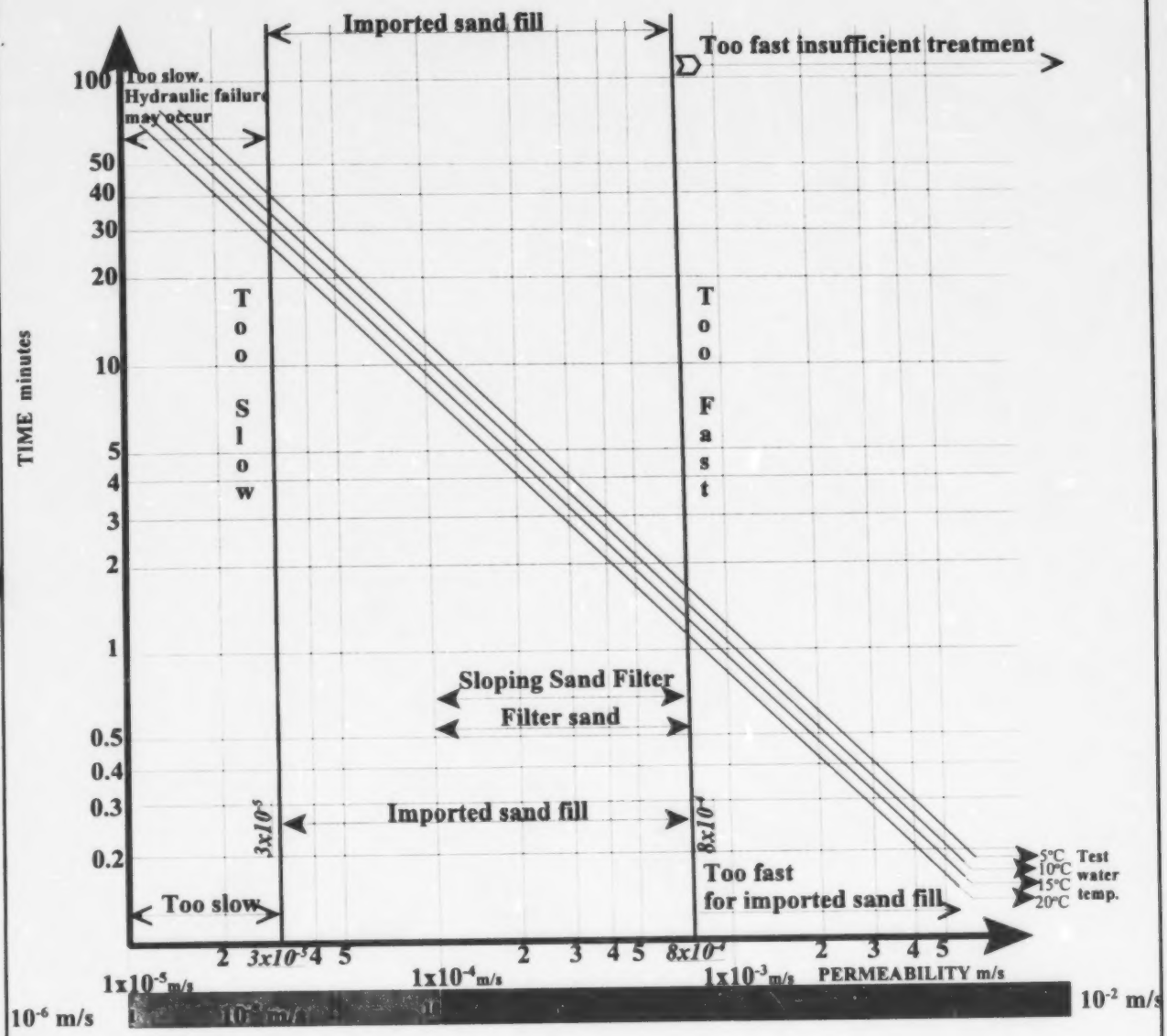
All dimention in milimeters (mm)



TESTING PROCEDURE

1. Saturate the sand to be tested with water avoiding ponding of the water on the top of the sample.
2. Add 60 mm of the sand to cylinder and drop cylinder five times 200 mm.
3. Add more sand to 110 mm and drop again five times 200 mm.
4. Place cylinder into container with water. When water surfaces remove cylinder and allow water to drain.
5. Compact sand again by dropping cylinder five times 200 mm.
6. Return cylinder to container with water. After the water surfaces pour carefully water into the top of the cylinder to level above upper reference mark.
7. Allow the water level to fall noting the time in minutes that it takes to pass over the 50 mm gauge length.
8. Refer to FIGURE B2 to determine sand suitability for septic system.
9. Clean cylinder and backwash filter fabric cover.

FIGURE B2



FALLING HEAD PERMMEAMETER
PERMEABILITY CHART

APPENDIX C

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SOILS IN-SITU

APPENDIX C

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SOILS IN-SITU

Saturated hydraulic conductivity (*Ks*) is a measure of the ease with which water flows through a saturated, permeable material. The higher the *Ks* value the greater the flow rate for a given hydraulic gradient. Due to air entrapment during the infiltration process, in-situ methods do not measure *Ks*, but rather a reduced field-saturated hydraulic conductivity Kfs (Elrick et al., 1984). In designing septic system drain fields *Kfs* is the preferred value to measure as the drainage process is designed not to occur in the field at complete saturation.

Measurement of Kfs is based on the observation that when a constant height of water is established in an augured hole in the soil, a bulb of saturated soil is established around the hole (Reynolds et al., 1986). After the establishment of the bulb the outflow of water from the well reaches a constant state. The Kfs of the area surrounding the hole can then be determined by measuring the constant outflow of water, along with the diameter of the well and the height of water in the well.

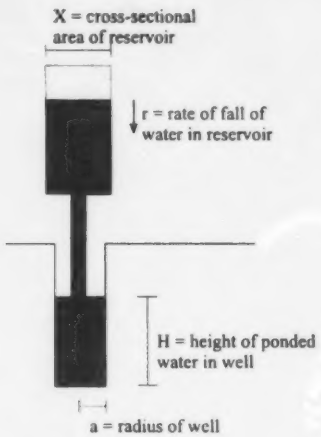


Figure 1. Permeameter setup

Permeameter calculations are based on the work of D. Elrick and W. Reynolds. The limitations and assumptions involved in this technique should be understood before it is used as a field assessment procedure. For an in depth review of this technique see: Reynolds, W.D. et al., 1992, An assessment of the single-head analysis for the constant head well permeameter, Can. J. Soil Sci. 72: 489-501.

One method of ensuring a constant head of water in an augered hole is through the use of a marriotte bottle or permeameter type device as shown in Figure 1. An air inlet hole at the desired height of the ponded water in the hole ensures a constant water level. By measuring the values show in Figure 1 and making an approximation of the soil type an appropriate C value can be selected from Figure 2 (or in Figure 3 in Elrick, 1986) and α^* from Table 1.

Table 1. Suggested I values*

I^* (cm^{-1})	Soil Structure and Texture
0.36	Coarse sands and highly structured soils
0.12	Most structured soils and medium and fine sands
0.04	Unstructured fine textured soils
0.01	Compacted clays (e.g. clay liners)

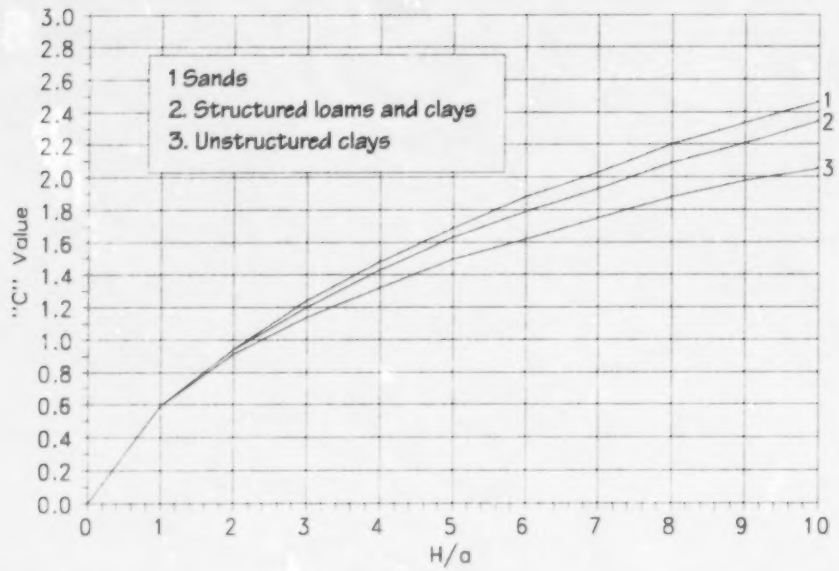


Figure 2. Determination of C values
(After Elrick and Reynolds, 1985)

Elrick (1986) notes that this method of calculation gives field-saturated conductivity (Kfs), which is roughly half the truly saturated hydraulic conductivity due to soil pores which may contain some entrapped air. Also noted in the above reference the use of the curves to determine the C value strictly speaking only applies for soils at about field capacity or drier and when the wetting front from the test holes does not appear at the soil surface.

The recommended determination of in-situ hydraulic conductivity by a consultant or site inspector is to: (1) examine a site to determine the most representative areas to measure, (2) examine the structure and texture of soil under consideration in order to estimate a value for

I*, and (3) use equation (3) to determine the best estimate of K_fs.

REFERENCES

Boersma, L., 1965, *Field Measurement of Conductivity Above a Water Table, Methods of Soil Analysis* Part 1, No. 9, in series on Agronomy, American Society of Agronomy Inc., Wisconsin, p. 234-252.

Elrick, D.E. and Reynolds, W.D., 1992, *Methods for Analyzing Constant Head Well Permeameter Data*, Solid Science of America Journal, In Press.

Elrick, D.E. et al, 1984, *The Guelph Permeameter for Measuring The Field-Saturated Soil Hydraulic Conductivity Above the Water Table*, from - Proceedings of the Canadian Hydrology Symposium No. 15 - 1984.

Reynolds, W.D. and Elrick, D.E., 1985, *Measurement of Field-Saturated Hydraulic Conductivity, Sorptivity and the Conductivity-Pressure Head Relationship Using the Guelph Permeameter*, Proceedings, National Water Well Association Conference on Characterization and Monitoring of the Vadose Zone, Denver, Colorado, November, 1985.

Reynolds, W.D. et al, 1986, *A Method for Simultaneous In-Situ Measurement in the Vadose Zone of Field Saturated Hydraulic Conductivity, Sorptivity and the Conductivity-Pressure Head Relationship*, Groundwater Monitoring Review, Vol. 6, pp 84-95.

Elrick,D.E. and W.D. Reynolds, 1986, *An analysis of the percolation test based on three dimensional saturated-unsaturated flow from a cylindrical test hole*, Soil Science, Vol. 142, No.5, pp 308-320.

PASK IN-SITU PERMEAMETER OPERATING INSTRUCTIONS

1. Loosen the ABS adjustable connector. Release and extend the small diameter tube fully. Re-tighten the connector.

2. Auger the hole to a depth of 18" - 20", using a standard auger which will give a hole a radius of 4 cm. Care should be taken to locate the hole in a location that will most closely represent the conductivity values of the area in question. Attention should be paid to any soil condition that may cause an erroneous high reading such as macro-pores due to excessive insect or rodent activity, roots, clay or gravel lenses or soil cracks.

3. If the soil is fine grained and wet it may be necessary to remove the smear layer, that may develop when auguring, from the sides of the hole with a brush. (A windshield snow brush with bristles cut to ¬ length will do.)

4. **Stand the device upside down, fill with water to the air inlet hole and insert the rubber stopper.**

5. **Invert the device rapidly and insert the hole until the rubber stopper rests on the bottom.**

6. **The constant head in the well is allowed to come to equilibrium, usually 5 to 30 minutes depending on soil type. The time interval and the reservoir water levels are recorded until the rate of fall becomes constant for at least 3 consecutive readings.**

7. **The rate of fall of water in the reservoir is calculated in cm/min (note: if the fall of water in the reservoir is fast the original readings can be done in cm/sec).**

The constant values describing the permeameter as shown on the worksheet, are used to calculate the field hydraulic conductivity.

CALCULATION SUMMARY

Following is a summary of the calculation of *Kfs* using equation (3) from the main paper. The calculation of > m, using equation (4), can be conducted in a similar manner.

To calculate *Kfs* you will need:

- **a - test hole radius (cm)**
- **H - height of air inlet hole from bottom of test hole (cm)**
- **C - from C vs. H/a graph**
- **I* - from table soil types**
- **X - cross-sectional area of permeameter reservoir (cmý)**
- **r - rate of fall of water in permeameter reservoir (cm/min)**

Calculate the rate of discharge of water using Q=X r (cm^3/min)

Equation (3) is

$$K_{fs} = cq/[2\Pi H^2 + \Pi a^2 C + 2\Pi H/\alpha^*]$$

rewriting gives:

$$K_{fs} = Q/\left[\frac{2\Pi H^2}{C} + \Pi a^2 + \frac{2\Pi H}{\alpha^* C}\right]$$

Where formula constants are grouped and named as *A* and *B*:

$$A = \frac{2\Pi H^2}{C} + \Pi a^2 \quad (3)$$

$$B = \frac{2\Pi H}{C} \quad (4)$$

To calculate the saturated field hydraulic conductivity.

$$K_{fs} = \left(\frac{Q}{A + \frac{B}{\alpha^*}} \right) \quad (5)$$

Similarly, the unsaturated matric flux potential may be calculated from:

$$\phi_m = \frac{Q}{A\alpha^* + B} \quad (6)$$

Sample Calculation

Soil type = loam, from Table 1 $\alpha^* = 0.12$ cm^{-1}
X= 51 cm^2
R = 0.3 cm/min
H = 20 cm
a = 4 cm

H/a= 20/4 = 5 therefore from Figure 2, C= 1.6

Q=X r
Q=51*0.3= 15.3 cm^3

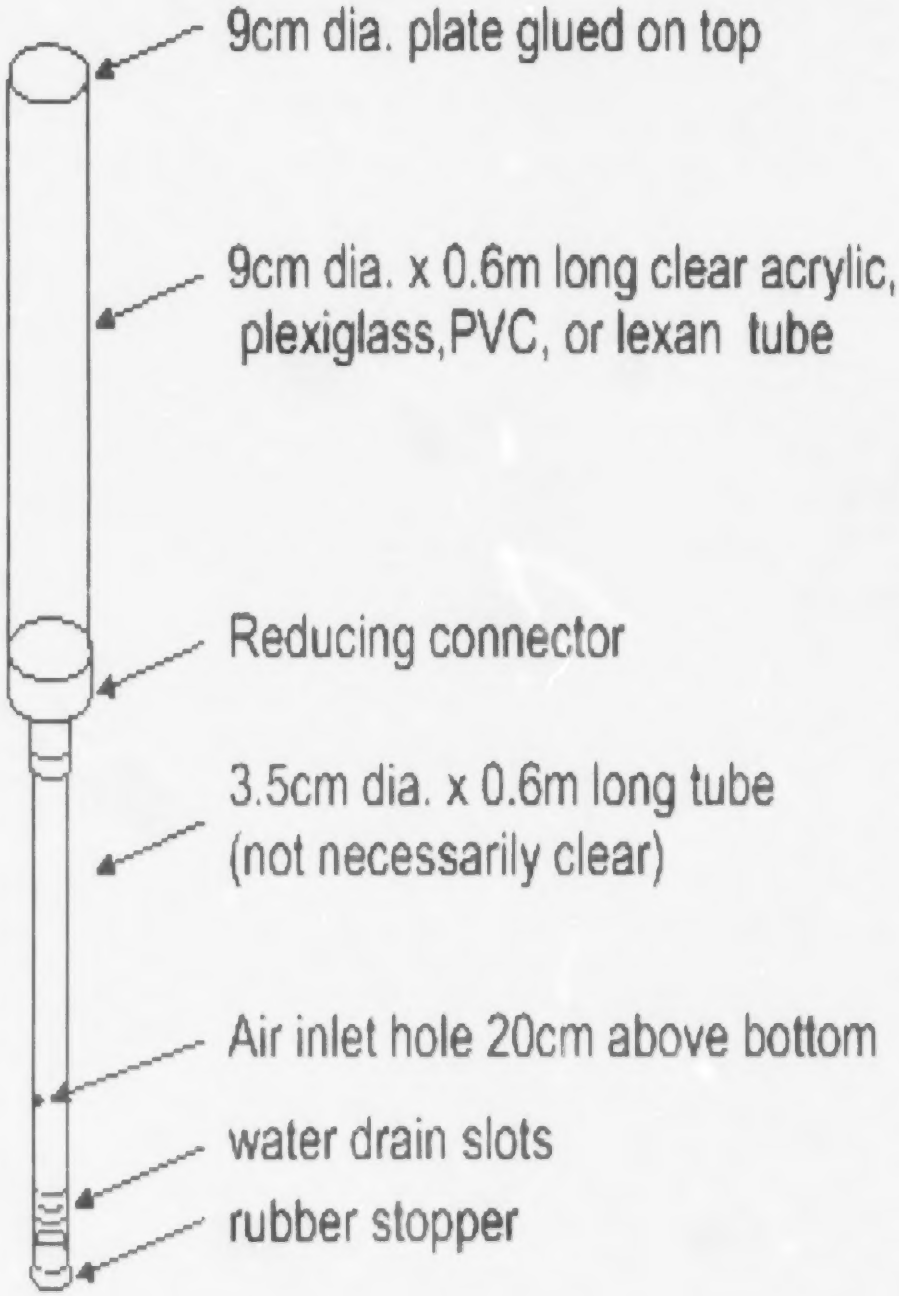
$A=(2\pi H^2)/C + \pi a^2$
$A=(2\pi 20^2)/1.6 + \pi 4^2$
A= 1621.1

$B=(2\pi H)/C$
$B=(2\pi 20)/1.6$
B=78.5

$K_{fs}=Q/(A+(B/\alpha^*))$
K_{fs}= 15.3/(1621.1+(78.5/0.12)
$K_{fs}=6.7 \times 10^{-3}$ cm/min $= 1.1 \times 10^{-4}$ cm/min

Pask In-Situ Permeameter

Construction Specifications


9cm dia. plate glued on top
9cm dia. x 0.6m long clear acrylic, plexiglass,PVC, or lexan tube
Reducing connector
3.5cm dia. x 0.6m long tube (not necessarily clear)
Air inlet hole 20cm above bottom
water drain slots
rubber stopper

Field Data Sheet

Reading Number	Time Interval (min)	Permeameter Water Level (cm)	Change in Water Level (cm)	Rate (r) (cm/min)

Calculations

1) $Q = (51.53) \times (\underline{\quad r \text{ (cm/min)} \quad}) = \underline{\qquad\qquad}$ cm³/min

2) $K = \dfrac{(\underline{\quad Q \quad})}{\left(621 + \dfrac{57}{(\underline{\quad \alpha^* \text{ (cm}^{-1}\text{)} \quad})}\right)} = \underline{\qquad\qquad}$ cm/min

(note: divide K by 60 to obtain answer in cm/sec); for values other than a = 4 cm, H= 10 cm, and cross-section X= 51.53 cm² new values of X, A, and B will have to determined as shown on the calculation summary sheet)

APPENDIX D

WATER MOVEMENT THROUGH SOILS

APPENDIX D

Water Movement Through Soils

A basic understanding of water movement through soils is needed to appreciate the necessity of determining a soil's permeability and its relationship to the design of a disposal field.

Water Movement Water moves through the voids between soil particles as a result of gravity. The rate of movement is governed by the size and shape of the voids through which water is pulled by gravity.

The basic factors which govern the quantity of water that can move through the soil on a lot are as follows:

Permeability The rate at which water will move through a soil. Soil permeability is determined by the size, continuity and tortuosity of the pores. Soils such as sand have large continuous pores which conduct more water than a clay which have small disconnected pores.

Porosity The percentage of a soil that is void of material. Porosity decreases with an increase of compaction, and/or grain size distribution. Particle shape also influences porosity. A soils porosity does not directly convert to a permeability value.

Hygroscopic Water The water which clings to a soil particle due to surface tension. The finer the grain size the greater the surface area is. As the surface area increases, more of the water in the pores attach to the soil particles through surface tension.

Hydraulic Gradient The surface slope of a water table. For disposal fields it is usually assumed that the hydraulic gradient parallels the ground surface. A sharp change in grade (ravine) within 50 feet of a system will change this.

Darcey's Law can be used to calculate the theoretical volume of water that will move through a soil under saturated soil conditions.

$Q = V * A$ Q = Volume of water
V = Velocity
A = Cross Sectional Area

$V = k * i$

K = Permeability
I = Hydraulic Gradient

Soil Saturation

Water Flow Water flows through saturated soils at a faster rate than it does through an unsaturated soil. Sewage treatment is most effective when working in unsaturated conditions.

Zone of Saturation The zone where all the soil voids are filled with water.

Hydrostatic Water Level The level of water surface in a hole dug into a saturated soil.

Capillary Fringe A layer of saturated soil above the zone of saturation. Water is drawn up by capillary action. The finer the soils the higher this zone will be. The soil is saturated above the water table.

Unsaturated Soil In an unsaturated soil the larger voids are filled with air and water moves through the smaller voids. With a sewage effluent the removal of pathogens is increased because they become trapped.

Boundary Layer The boundary between layers of soil with different hydraulic conductivities interferes with water movement. The depth to which the water ponds is dependent on the difference in conductivity.

Infiltrative Surface The interface between the disposal field and the natural soil, where the effluent must enter the soil. The pores in the soil must be open for the sewage to pass through. If the pores become blocked during construction, the bed will not be able to operate at its full potential. The pores will also become partially blocked by the clogging mat. Steps can be taken to avoid or minimize damage to this vital component. Contractors should not work when the soil is saturated, the area should be hand raked, sand and gravel should be placed carefully.

APPENDIX E

SELECTION EXAMPLE

Disposal System Selection Example

Site conditions:

- Slope 9%
- Test pit data:

Organic Mat	- 100 mm	*- this is not a permeable soil*
Silty sand	- 200 mm ,loose, brown	*-permeable soil*
Sandy Silt	- 790 mm, loose ,brown ,dry	*-permeable soil*
Clay	-700 mm, dense, moist	*-not (or slow) permeable*
Silty sand	- 200 mm, loose, saturated	*-permeable but saturated, not usable for disposal field installation*
Water at 50 mm from test pit bottom and rising		
Roots penetration approximately 500 mm		

Project: 3 bedroom single family home

SELECTION:

1. Calculate total soil depth
   - 200 +790 + 700 + 200 = **1890 mm** (organic mat not included)
2. Calculate permeable soil depth
   - 200 + 790 = **990 mm** (organic mat, clay and saturated sandy silt are not included)
3. Calculate depth to groundwater
   - 200 + 790 + 700 = **1690 mm** (Saturated silty sand is assumed to represent ground water level Fully trenched C1 system can be installed as there is more than 1650mm of soil above ground water level)
4. Although permeable soil consist of two different soil types, the one with lower permeability will be used to make system selection. In this example we assume that we have 990 mm of sandy silt.

Selection Criteria: Flow - 1000l ; Soil - 990mm of sandy silt.; Slope 9%

TABLE 4.2

DISPOSAL SYSTEM SELECTION OPTIONS

**Not all options provided are suitable for each property being assessed, separation distances to water table etc must be taken into consideration.*

Permeable Soil Depth (mm)	Slope less than or equal to 3 %	Slope greater than or equal to 3% and less than 5%	Slope 5% to 30%	Slope over 30%
0 to less than 300	Mound	Mound	C3, C2(r)	Not Acceptable For Selection. Design Only By A Level 1 Qualified Person
300 to less than 600	Mound	C2, Mound, C2(r)	C2, C3, C2(r)	
600 to less than 750	Mound Area Bed	C2, C2(r) Mound	C2, C3, C2(r)	
750 to less than 1300	Multiple Trench(r) Area Bed(r), Mound	C1, C2, C2(r), Mound	C1, C2, C3, C2(r)	
over 1300	Area Bed, Multiple Trench, Mound	C1, C2, C2(r), Mound	C1, C2, C3, C2(r)	

Table 4.2 (page59) indicates a following selection choices for the lot described in this example : C1, C2,C2(r),C3.
Since the cost of the system increases with the amount of imported sand fill required for its construction the most economic choice will be a C1 type sewage disposal system. It will also offer the best health protection as sewage flow is contained entirely within soil matrix.

After decision have been made to select C1 type disposal bed, we select length of the system from table 4.4a (pages 60 to 67), as shown in the example below.

Table 4.4a shows following system parameters for the selection criteria indicated below.

(Selection Criteria: Flow - 1000l ; Soil - 990mm of sandy silt.; Slope 9%)

$L_{(\text{total system length})}$ = 57 meters (*Note: should the width of the lot permit it is advisable to install system as long as possible)*
$C_{(\text{front cut})}$ = 0.6 meter
$D_{(\text{minimum required soil depth above water, bedrock etc})}$ = 1.65 meter, since calculated depth to groundwater is 1690mm (1.69 m) a fully trenched C1 system can be installed on this lot.

TABLE 4.4 A C1 SYSTEM SELE

Slope % L = pipe length in meters; C= front cut

Soil Type	Depth of Permeable Soil (mm)	3	4	5	6	7	8	9	10	11	12
Sandy Silt *Permeability:* 3E-6 m/s (0.259 m/d)	750 to 899									L= 58	L= 54
	900 to 999							L 57	L =51	L= 47	L= 43
	1000 to 1099						L = 57	L = 50	L =45	L= 41	L= 38
	1100 to 1199					L =	L =	L =	L =4	L= 37	L= 34

After selecting disposal bed length (L), width of the disposal bed should be selected from table 4.5 of the Guidelines, as shown below.

The selected width for 57 m long system is:

$W_{(width)} = 0.6$ m

TABLE 4.5
Determination of Disposal Field Widths in Meters

Length of Trench (m)	Flow (Liters per day)	
	1000	1500
	Width in M	Width in M
25	1.2	1.8
26	1.2	1.7
27	1.1	1.7
28	1.1	1.6
29	1.0	1.6
30, 31	1.0	1.5
32, 33, 34	0.9	1.4
35, 36	0.9	1.3
37, 38, 39	0.8	1.2
40	0.8	1.1
41, 42, 43	0.7	1.1
44, 45, 46	0.7	1.0
47	0.6	1.0
48, 49, 50, 51, 52	0.6	0.9
53, 54, 55, 56, 57, 58, 59	0.6	0.8
60	0.6	0.7

Next we have to select septic tank size from table 3.1 page 31 of the Guidelines.
For three bedroom house assumed in this example minimum required volume of the septic tank is :

V = 2800l (*Note: should a home owner whish to install a garbage grinder capacity of the tank should be increased by 20% i.e volume would increase to 1.2*2800 = 3,360 l.)*

After all the parameters of the disposal bed have been selected, sketch of the cross section should be prepared indicating all pertinent dimensions and specifications. A standard cross sections shown in Appendix I can be used for that purpose. To complete the process a sketch of the proposed lot lay out should be prepared and Application to install disposal system completed and signed. (See example below)

When preparing lot lay out remember to indicate location of all buildings, wells on design and adjanced properties (including type), watercourses, water resources, bedrock outcrops, driveway and any other pertinent information that may have impact on disposal bed location. (Refer to

SUBMISSION STANDARDS FOR APPLICATIONS FORM

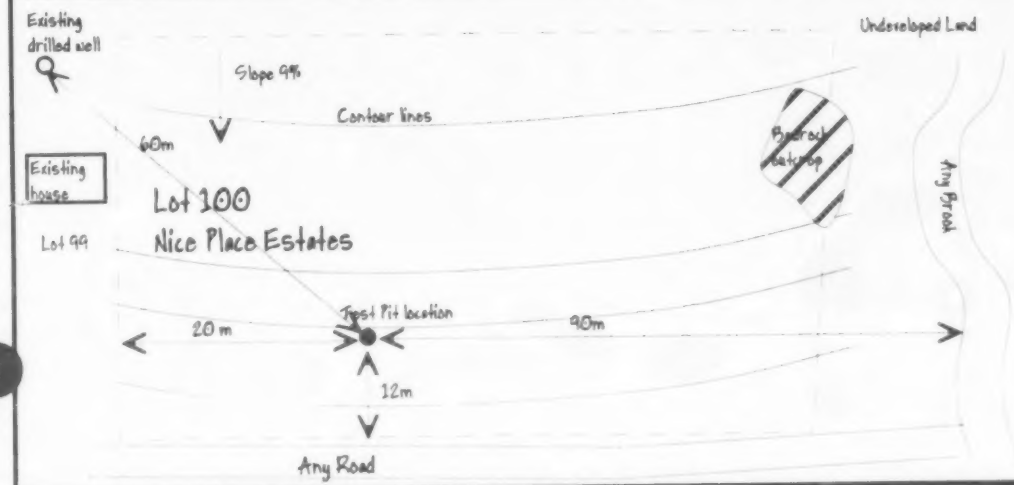
All applications must comply with the Act, Regulations, Guidelines and any policies within the Department. A completed copy of this form should accompany each application.

APPLICANTS NAME: John T Doe **APPLICATION #:**

SUBDIVISION NAME: Nice Place Estates **LOT NUMBER:** 100

SITE EVALUATION OF LOT

*Sketch of lot, location of soil evaluation tests, direction of slope, watercourse and other features that may influence the selection or design of the system.



SOIL EVALUATION TESTS

TEST PIT PROFILE (M)

TOTAL DEPTH:	1.89	M
BEDROCK AT:	over 1.69	M
WATER TABLE:	1.69	M
SLOPE:	9	%
ROOTS TO:	0.5	M
MOTTLING AT:	No mottling	M

Permeability of soil in-situ:	Not tested
Flow rate:	N/A
Test method:	N/A

SOIL STRATUM	SOIL TYPE	DEPTH OF SOIL (mm)	DENSITY	MOISTURE
ORGANIC	organic mat	100	N/A	dry
1ST layer	Silty Sand	200	loose	dry
2ND layer	Sandy Silt	790	loose	dry
3rd layer	Clay	700	dense	moist
4 th layer	Silty Sand	200	loose	saturated

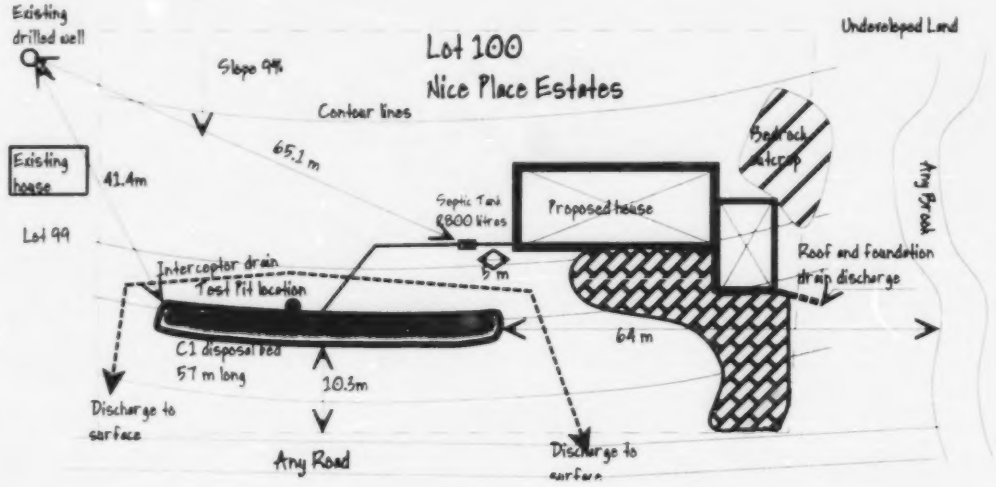
APPLICANTS NAME: John T Doe **APPLICATION #:** _____

SYSTEM SELECTION CRITERIA			
Daily flow	**Soil Type**	**Soil permeability**	**Depth of permeable soil**
Litres/day: 1000	Sandy Silt	m/s: 3E-6	mm: 900

SYSTEM SELECTION FROM TECHNICAL GUIDELINES			
Type of Disposal Field:	C1	**Imported sand fill required**	❑ YES X NO
Dimensions:	57 L x 0.6 W	**Permeability Rate**	N/A m/sec
Cut at Toe of Trench:	650 mm	**Width of Buffer** -downslope -upslope	N/A M M
Interceptor Trench	X YES ❑ NO depth: ____	**Depth of Buffer**	N/A mm
Pump or Siphon Capacity	N/A Litres	**Septic Tank Capacity**	2800 Litres

DRAWING OF PROPOSAL

* Sketch of On-site Sewage Disposal System Selection/Design



* Cross sectional diagrams of proposal to be attached to this form for submission.

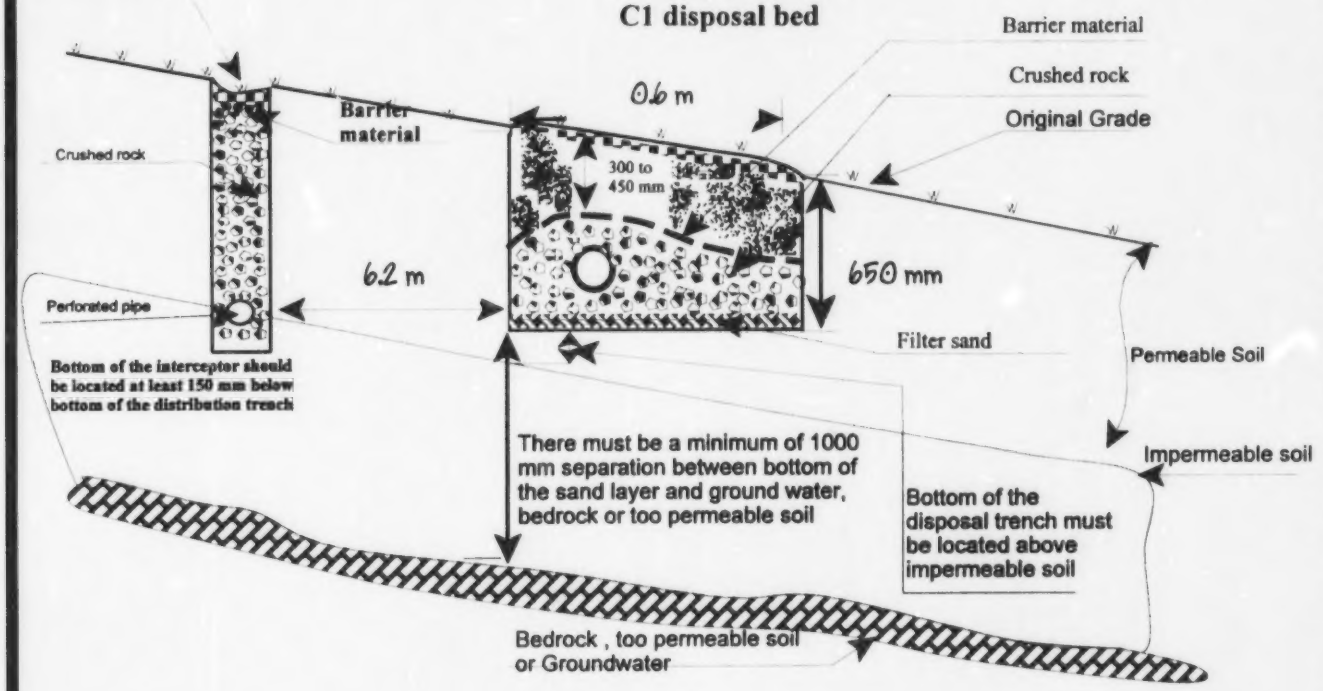
DATE: February 10, 2000 **QUALIFIED PERSON:** John Anyname
(PRINT NAME)

CERTIFICATE OF QUALIFICATION #: 1234 John Anyname
(SIGNATURE)

DOE dated February 4, 2000

SCHEDULE C

C1 disposal bed


Interceptor swale
Barrier material
Crushed rock
Original Grade
0.6 m
Barrier material
Crushed rock
300 to 450 mm
6.2 m
650 mm
Perforated pipe
Filter sand
Permeable Soil
Bottom of the interceptor should be located at least 150 mm below bottom of the distribution trench
There must be a minimum of 1000 mm separation between bottom of the sand layer and ground water, bedrock or too permeable soil
Impermeable soil
Bottom of the disposal trench must be located above impermeable soil
Bedrock , too permeable soil or Groundwater

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.

Disposal system must be installed by a contractor licensed to install on-site sewage disposal systems in Nova Scotia.

All work must be completed in accordance with a Nova Scotia On-Site Sewage Disposal Systems Regulations, On-Site Sewage SystemsTechnical Guidelines, and conditions of this approval.

Roof, foundation and lot drainage must be directed away from the disposal field, septic tank and pump (siphon) chamber.

Steps must be taken to ensure that the proposed disposal field areas are not subject to vehicular traffic or any other disturbance such as excavation or stockpilling of excavated material etc., installation of physical barrier is recommended.

It is applicants responsibility to assure that construction of foundations, driveway, well or any other development on the lot will not impact on feasibility of on site sewage disposal field installation.

Contractor is responsible for pump selection and installation (if pump required by approval.)

yes	N/A	Top soil seed or sod		
400	mm	Clean local backfill		
yes	N/A	Barrier material		
75	mm	Crushed rock above pipe		
75	mm	Perforated pipe diameter		
57	m	Perforated pipe length		
125	mm	Crushed rock below pipe		
75	mm	Filter sand		
4E-4	m/s	Filter sand permeability	minutes at	2
1.2	m	Interceptor trench depth		

End of the interceptor must extend to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separattion distances.

NOT TO SCALE

Applicant	John Doe
Approval No:	
Location	Lot 100 Nice Place Estates

C2 SELECTION EXAMPLE

Disposal System Selection Example
C2 System Selection

Site conditions:

- Slope 7%
- Test pit data:

Organic Mat	- 100 mm	- *this is not a permeable soil*
Sandy Silt	- 300 mm ,loose, brown	- *permeable soil*
Silty Sand	- 200 mm, loose ,brown ,dry	- *permeable soil*
Clay	- 700 mm, dense, moist	- *not (or slow) permeable*
Silty Sand	- 200 mm, loose, saturated	- *permeable but saturated, not usable for disposal field installation*
Water at 50 mm from test pit bottom and rising		
Roots penetration approximately 500 mm		

Project: 3 bedroom single family home (Flow = 1000L/Day)

SELECTION:

1. Calculate total soil depth
   - 300 +200 + 700 + 200 = **1400 mm** (organic mat not included)
2. Calculate permeable soil depth
   - 300 + 200 = **500 mm** (organic mat, clay and saturated sandy silt are not included)
3. Calculate depth to groundwater
   - 300 + 200 + 700 = **1200 mm** (Saturated silty sand is assumed to represent ground water level.
4. Although the permeable soil consist of two different soil types (sandy silt and silty sand), the one with lower permeability (sandy silt) will be used to make system selection. In this example we will assume that we have 500 mm of sandy silt.

Selection Criteria: Flow - 1000l ; Soil - 500mm of sandy silt.; Slope 7%

TABLE 4.2
DISPOSAL SYSTEM SELECTION OPTIONS

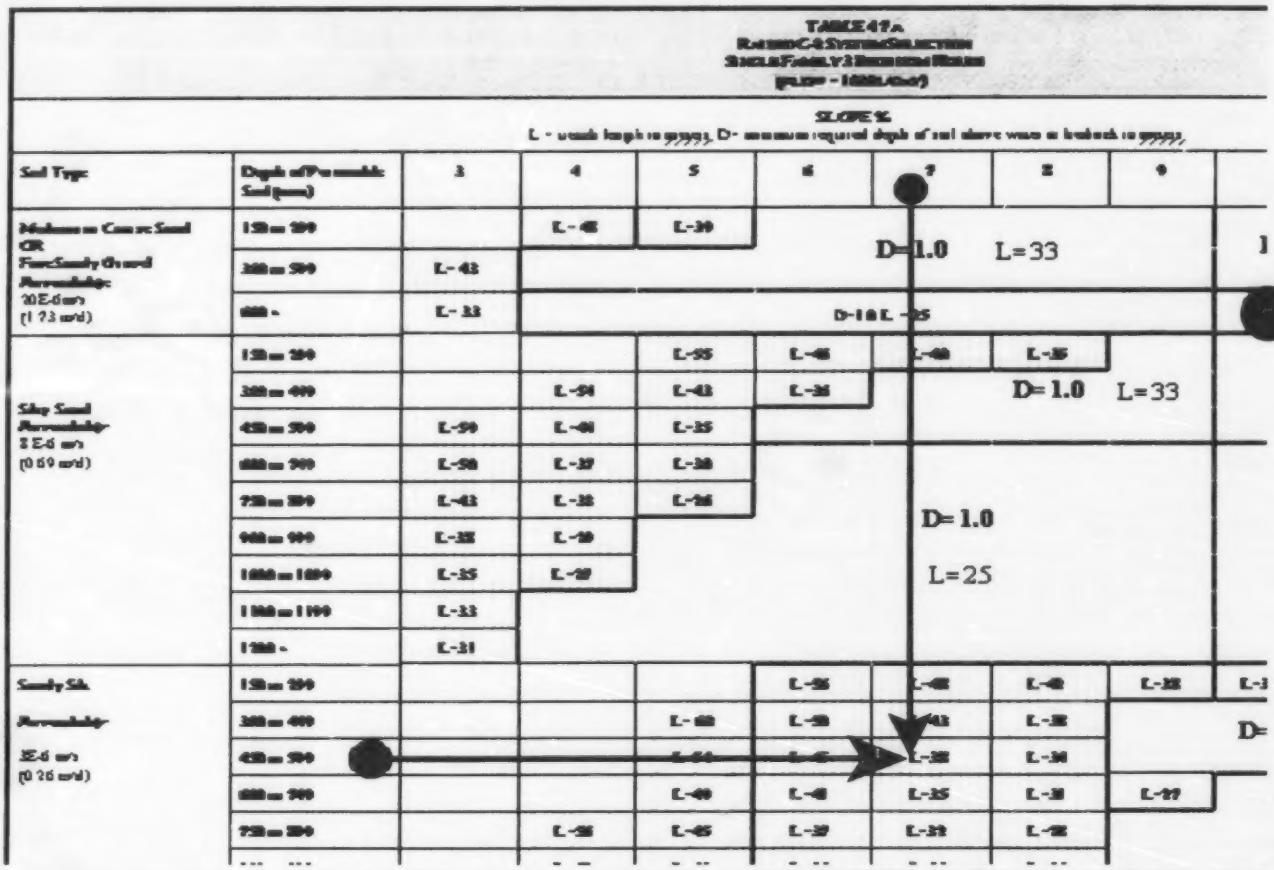
Permeable Soil Depth (mm)	Slope less than 3 %	Slope greater than 3% and less than 5%	Slope 5% to 30%	Slope over 30%
0 to less than 300	Mound	Mound	C3, C2(r)	Not acceptable
300 to less than 600	Mound	C2, Mound, C2(r)	C2, C3, C2(r)	
600 to less than 750	Area Bed(r), Mound	C2, C2(r) Mound	C2, C3, C2(r)	
750 to less than1300	Area Bed(r), Mound	C1, C2, C2(r), Mound, Area Bed(r)	C1, C2, C3, C2(r)	
over 1300	Area Bed, Multiple Trench, Mound	C1, C2, C2(r), Area Bed, Multiple Trench, Mound	C1, C2, C3, C2(r	

Table 4.2 indicates a following selection choices for the lot described in this example : C2,C2(r),C3. Since the [illegible] of the system increases with the amount of imported sand fill required for its construction the most economic choice will be a C2 type sewage disposal system.

After decision has been made to select a C2 type disposal field; select length of the system from table 4.7A as shown in the example below.

Table 4.7A shows following system parameters for the selection criteria indicated below.

(Selection Criteria: Flow - 1000l ; Soil - 500mm of sandy silt.; Slope 7%)



otal system length) = 38 meters (*Note: should the width of the lot permit it is advisable to install system as long as ossible)*
D(minimum required soil depth above water, bedrock etc) = 1.0 meter, since calculated depth to groundwater is 1200mm (1.2 m) a C2 system can be installed on this lot.

If the calculated depth to groundwater, bedrock or unacceptably high permeable soil (step 3 above) is not equal to or greater than the D required in table 4.7A (1.0 m in this example); a C2 **cannot** be used and either a C2(r) or C3 will have to be selected.

After selecting disposal field length (L), width of the disposal trench should be selected from table 4.5 of the Guidelines, as shown below.

TABLE 4.5
Determination of Disposal Field Widths in Meters

Length of Trench (m)	Flow (Litres per day)	
	1000	1500
	Width in M	Width in M
26	1.2	1.8
26	1.2	1.7
27	1.1	1.7
28	1.1	1.6
29	1.0	1.6
30, 31	1.0	1.5
32, 33, 34	0.9	1.4
35, 36	0.9	1.3
37, 38, 39	0.8	1.2
40	0.8	1.1
41, 42, 43	0.7	1.1
44, 45, 46	0.7	1.0
47	0.6	1.0
48, 49, 50, 51, 52	0.6	0.9
53, 54, 55, 56, 57, 58, 59	0.6	0.8
60	0.6	0.7

The selected width for 38 m long system is:

$W_{(width)} = 0.8$ m

Next we have to select septic tank size from table 3.1of the Guidelines.
For three bedroom house assumed in this example minimum required volume of the septic tank is :

V = 2800l (*Note: should a home owner whish to install a garbage grinder capacity of the tank should be increased by 20% i.e volume would increase to 1.2*2800 = 3,360 l.)*

After all the parameters of the disposal field have been selected, a sketch of the cross section should be prepared indicating all pertinent dimensions and specifications. A standard cross sections shown in Appendix I can be used for that purpose. To complete the process a sketch of the proposed lot lay out should be prepared and the Application to install the on-site sewage disposal system completed and signed. (See example below)

When preparing the lot lay out remember to indicate location of all buildings, wells on this lot and all adjacent properties (including type of well), watercourses, water resources, bedrock outcrops, driveway and any other pertinent information that may have impact on disposal field location.

MOUND SELECTION EXAMPLE

Disposal System Selection Example
Mound Disposal Field

e conditions:

Test pit observations:

0 to 25 mm- Organic mat (dark brown forest litter)
25 to 750 mm- Sandy silt (reddish brown with root penetration to 350mm but no mottles)
below at 750 mm- Silty clay (reddish and very compact soil mottles give evidence that a seasonal water table could be present at the 750 mm level no roots)
No evidence of water table or bedrock at the bottom of test pit, 1.5 m depth but there has been no rain for three weeks and soil conditions are extremely dry.

Site inspection field notes included the following:

Lot dimensions - 50 m x 100 m (existing lot created in 1954)
Slope down slope of proposed system 4%
Long slope up hill of proposed system - interceptor will be required
Driveway will be a concern. Line will have to cross under driveway between tank and disposal field. Also driveway cannot be located in area proposed by owner but must be kept within ten feet of easterly lot line.
The only suitable location for the dug well is on upper side of house at least 100 feet from system
There is a consistent contour in area of proposed system where a system up to 40 m could be installed and still meet all separation distances

Proposed development:

Four bedroom house, two bathrooms but no hot tub or garborator.

Selection Procedure:

1) Check selection options available from Table 4.2
Options include: C2, C2(r) or Mound for 4% and 725 mm sandy silt

2) Check Table 4.6.b to see if a C2 is suitable for 725 mm of sandy silt at 4%
C2 is not suitable

3) Check Table 4.7.b to see if a C2 is suitable for 725 mm of sandy silt at 4%
C2(r)is not suitable.

4)Check requirements of Section 4.8 to see if a Mound will be suitable

- ❑ Flow 1500 l/day
- ❑ Slope is less than 5%
- ❑ For a flow of 1500 l/day select a 38m mound
- ❑ Depth to water table is 750 mm below grade, once the organic layer is removed below the mound, the water table will be 725 mm below the bottom of the sand. The

minimum amount of sand allowed under the bottom of the disposal trench is 600 mm. therefore the separation from the bottom of the trench to high water table will be 600 + 725 = 1325 mm. This is greater than the 1 m minimum requirement therefore use 600 mm imported sand fill under the trench.

- ❑ Select other dimensions from figure 4.G to 38 m Mound having 600 mm imported sand fill under the tench. An Interceptor is also required up slope from the Mound.

This Mound will fit on the lot and meet all the requirements of the regulations and guidelines. If for any reason the selector feels that a longer Mound would be more appropriate, the length should be increased.

Note: If it were not possible to select a mound for this site, no system could be selected. The only way that approval to install a system could be obtained in that case would then be if a QP1 could design a system to fit on the lot. One situation in the above example where it would not have been possible to select a system would have occurred if the available length on the lot for the mound was less than 38m.

C3 SELECTION EXAMPLE

Disposal System Selection Example
C3 Disposal Field

e conditions:

Test pit observations:

0 to 50 mm- Organic mat (dark brown to back)
50 to 190 mm- Sandy silt (reddish brown with root penetration but no mottles)
below at 190 mm- Silty clay (reddish and very compact but no mottles and no roots)
No evidence of water table or bedrock at the bottom of test pit, 1.5 m depth

Site inspection field notes included the following:

Lot dimensions - 100 m x 300 m
Slope down slope of proposed system 16%
Small brook approximately 85m down slope of proposed system-not a concern
Long slope up hill of proposed system - interceptor will be required
Keep driveway toward west boundary to avoid system
Locate dug well on upper side of house at least 100 feet from system
There is a consistent contour in area of proposed system where a contour system up to 100 m could be installed and still meet all separation distances

Proposed development:

Three bedroom house, two bathrooms but no hot tub or garborator.

ection Procedure:

1) Check selection options available from Table 4.2
Options include: C3, or C2(r) for 16% and 140 mm sandy silt

2)Check Table 4.7a to see if a C2(r) is suitable for 140 mm of sandy silt at 16%
C2(r) is not suitable

3)Check requirements of section 4.7 to see if a C3 will be suitable

- ❑ Flow 1000l/day
- ❑ Slope is greater than 5%
- ❑ Minimum trench length 25m
- ❑ Separation to ground water, bedrock, or soil with unacceptable high permeability is not a concern so use 600mm imported fill under the trench
- ❑ Select other dimensions from figures 4.E and 4.F to go with the 25 m C3 having 600 mm imported sand fill under the rock trench

This C3, with interceptor, will fit on the lot and meet all requirements of the Guidelines. If for any reason the selector feels that a longer C3 would be more appropriate the length should be increased.

AREA BED AND MULTIPLE TRENCH SELECTION EXAMPLE

Disposal System Selection Example
Area Bed or Multiple Trench System

e conditions:

Test pit observations:

0 to 60 mm- Organic mat (dark brown forest litter)
60 to 700 mm- silty sand (reddish brown and loose with root penetration to 600mm appears well drained, a few cobbles up to 100mm in diameter)
700 mm to 1500 mm- sandy silt (reddish, moderate compaction no evidence of soil mottles or water table, some rounded cobbles up to 150 mm in diameter)
No evidence of water table or bedrock to bottom of test pit, 1.5 m depth but there has been no rain for three weeks and soil conditions are extremely dry.

Site inspection field notes included the following:

Lot dimensions - 40 m x 75 m (existing lot created in 1975)
Slope down slope of proposed system 2.5%
Long slope up hill of proposed system - interceptor swale will be required.
Lot slopes away from house to rear of the lot so driveway will not be a concern however there is an existing drilled well 10 m beyond the downslope boundary System should be kept as far away as possible, at least 25 m up slope from the lot boundary .
The most suitable location for the drilled well on this lot is on the upslope side of the house at least 15.2 m from the system
Although there is little slope on the lot (2.5 %) the contour runs almost perpendicular to the 75m lot line which leaves a distance of 40 m available along the contour for a system not counting separation distances.

Proposed development:

Three bedroom house, two bathrooms, no hot tub or garborator, no plumbing in the basement.

Selection Procedure:

Check selection options available from Table 4.2

Options include: Area Bed, Multiple Trench, or Mound for 1.5m permeable soil and less than 3% slope. In this example, the selector decided to see if either a multiple trench or area be could be used and then determine which system would be most appropriate for the lot.

NOTE: If an area bed of trench system can be selected, one of these systems would be the preference to a mound system as either of these systems should be less expensive and should blend into the landscape better than a mound. In most cases the conditions that allow the selection of an area bed or trench system are the same and it is up to the selector to decide which system is more appropriate. The only case where an area bed can be selected and a trench system cannot be selected is when there is between 600 and 750 mm of permeable soil

on the lot. In situations where a multiple trench field can be selected an area bed can always also be selected.

Follow the selection procedure outlined in section 4.9.2 for the area bed

1) Average daily flow for 3 bedroom home 1000 l/day
2) Ground slope less than 3%
3) Total depth of permeable soil = 640 mm silty sand + 800 mm sandy silt = 1440 mm. Use the least permeable soil type i.e.. sandy silt.
4) This depth of permeable soil and no restrictive layers will allow a fully trenched area bed system.
5) For sandy silt and 1000 l/day Table 4.9 requires an area bed with an area of 125 m^2 and a minimum cross slope dimension of 25 m. Site inspection notes show that up to 40 m along the slope is available, not counting separation distances. If we allow 5 m to each lot boundary (3 m is the minimum) this leaves 30 m for the bed. Therefore make the bed 30 m x 4.2 m.

Follow the selection procedure outlined in section 4.9.3 for the multiple trench field.

a) Average daily flow for 3 bedroom home 1000 l/day
b) Ground slope less than 3%
c) Total depth of permeable soil = 640 mm silty sand + 800 mm sandy silt = 1440 mm. Use the least permeable soil type i.e.. sandy silt.
d) This depth of permeable soil and no restrictive layers will allow a fully trenched system.
e) For sandy silt and 1000 l/day Table 4.10 requires a total of 100 m of trench. with a minimum cross slope of 25 m. Site inspection notes show that up to 40 m along the slope is available, not counting separation distances. If we allow 5 m to each lot boundary (3 m is the minimum) this leaves 30 m for the field. It is difficult to get even distribution to a gravity fed trench system with un even number of trenches. Therefore extend the trench length to 30m but still use four trenches, giving a total tench length of 120m.The minimum trench width is 600 mm.

The selector would then decide if the use of an area bed 30 m x 4.2 m or a multiple trench field consisting of 4 trenches 30 m long and 0.6 m wide would be the most suitable solution for the lot. Pipe location and other details would be obtained from Section 4.9 plus the system diagrams.

This area bed or multiple trench field will fit on the lot and meet all the requirements of the regulations and guidelines. If it were not possible to select an area bed or multiple trench field for this site it may be possible to select a mound. If a mound could not be selected, the only way that approval to install a system could then be obtained would be if a QP1 could design a system to fit on the lot.

APPENDIX F

Flow Tables

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Appendix F

1. The individual on-site sewage disposal system shall be designed and constructed to adequately treat and dispose of the expected maximum flow of sewage.

2. The disposal system must be designed to receive all sewage from the building or structure except cooling water, roof, foundation or surface drains or backwash from water treatment devices, unless otherwise approved by the Department.

3. The minimum design sewage flow from any residential structure or dwelling including multiple units, apartments, etc., shall be 1000 L/day. When it is anticipated that the sewage flows from the dwelling or structure will exceed the 1000 L/day minimum, it is recommended that the sewage flows as indicated in the following table be utilized:

Dwelling Type	Average Daily Flow (L/Day)
3 bedroom unit	1000
3 bedroom with high water use fixtures	1200
4 bedroom unit	1350
4 bedroom unit with high water use fixtures	1500
each additional bedroom unit	350
each additional bedroom unit with high water use fixtures	500

When the occupancy of a dwelling unit exceeds two persons per bedroom, it is recommended that the sewage flow be determined by adding 175 L/day of sewage flow for each additional person.

4. Industrial wastewater shall not be discharged into on-site sewage disposal systems designed for sanitary sewage disposal unless prior approval is obtained from the Department of the Environment. Special designs or pretreatment may be required for industrial waste-water.

5. All restaurants or other establishments involved in food preparation activities

shall install external grease traps when required by the Department.

6. The recommended minimum design sewage flows from other residential, commercial, institutional buildings or structures should be as prescribed in this appendix.

7. Where actual metered flow data indicating maximum daily flows are available, such flow data may be substituted for the sewage flows listed in this appendix, under the following conditions:

   - They should cover the most recent 6-12 month period of continuous operation (or 3 full seasons).

   - They must be from the same or a similar facility.
     (Size, activity, geographical location, open hours, production or occupancy volume, usage pattern, etc.)

   - A 20 to 50 percent increase factor should be used in the design flow to accommodate potential future flow increases, occasional peaks, etc.

   - If less than 6-12 months of flow data is available, or only average flows for entire measured period exists (*i.e no daily readings only average for the entire period*), they should be increased by up to100 percent in the design (or seasonal activity)

   - Flow meter data should also include information regarding actual occupancy or production volume when unit flows are calculated.

9. A reduction in the design flows may be allowed by the Department when a permanent low-volume device are to be installed in the proposed building or structure. Manufacturer's data sheets should be presented on all water saving plumbing devices proposed for use with on-site sewage disposal systems. Consideration will include contribution of water saving devices to total flow, safety factor.

10. When total length of sewer between building and disposal bed exceeds 200 meters the design flow should include allowance for infiltration.

11. Design flows in appendix are recommended minimal design flows and if evidence of larger flows exist or expected, the larger flows should be used.

Facility	Unit of measure	Minimum design flow Litres	Comments
Assembly Halls: No kitchen or meals	person	8	
Assembly Halls: With varying facilities	person	9	
Churches With kitchen	seat	26	
Churches No kitchen	seat	9	
Churches Kitchen & paper service	meal	4.5	
Churches Kitchen & normal service	meal	13.5	
Churches Suppers	person	45	
Fire station Without full time employee, floor drains or food	person	19	
Town Hall	seat	19	
Medical/personal care			
Hospital	bed	409	
Hospital Including laundry	bed	750	
Hospital Excluding laundry	bed	550	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Hospital mental	bed	340	
Hospital mental Add per employee	employee	23	
Special care home	resident	136	
Special care home Add per employee	employee	45	
Medical Office Doctors nurses medical staff	person	273	
Medical Office Office staff Add	person	73	
Medical Office Patient Add	person	23	
Dental Office	chair	757	
Dental Office Staff Add	person	132	
Schools			
School Cafeteria & gym & shower	student	68	
School Cafeteria only	student	45	
School Gym only	student	68	
School Washrooms only	student	13.5	
School Elementary	student	26	

Facility	Unit of measure	Minimum design flow Litres	Comments
School High	student	45	
School Junior high	student	34	
School Boarding Resident student	student	136	
School Boarding non-resident staff	person	50	
Prison			
Prison	inmate	136	
Prison Add for personnel	employee	23	
Food Service			
Bakery	employee	68	
Bar/Longue	customer	8	
Bar/longue	seat	125	
Restaurant Not 24 hr	meal	9	
Restaurant Not 24 hr	seat	31	
Restaurant Auto dishwasher - Add	seat	12	
Restaurant 24hr dishwasher and/or food waste disposer	seat	23	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Restaurant 24 hr	seat	189	
Restaurant 24hr highway	seat	265	
Restaurant 24 hr highway & showers	seat	400	
Restaurant Kitchen & toilet waste only	seat	113	
Restaurant Kitchen & toilet waste only	patron	30	
Restaurant Kitchen waste only	meal	11	
Restaurant Banquet rooms-each banquet	seat	30	
Restaurant Drive in	seat	125	
Restaurant Drive in, all paper	car space	57	
Restaurant Drive in all paper inside seat	seat	57	
Taverns/Bars/Longues with minimal food service	seat	76	
Night Club/Restaurant	seat	113	
Restaurant/Dinning rooms/Dinning longues	square foot of dinning area	9	
Take-Out	square foot	2	

Facility	Unit of measure	Minimum design flow	Comments
		Litres	
Banquet and Dinning rooms	square foot	1.5	
Caterers	patron	45	
Cafeteria	customer	4.5	
Coffee Shop	customer	19	
Coffee Shop Add per employee	employee	36	
Dinning Halls	meal	18	
Airport	passenger	9	
Airport Add for each employee	employee	41	
Beauty salon	station	400	
Beauty salon Add for personnel	person	38	
Veterinary clinic(3 doctors or less) No boarding	total	2900	
Veterinary clinic(3 doctors or less) Boarding	total	5700	
Dog kennel	enclosure	73	
Laundromat Self serve	machine	1514	
Laundromat Per wash	wash	168	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Laundromat In apartment building	machine	1135	
Commercial/Shopping			
Department store	toilet room	1513	
Department store	employee	36	
Shopping center No food, laundry	parking space	4	
Shopping center	employee	40	
Shopping center Washrooms only	square metre of store space	5	
Shopping center Toilet rooms	each	1665	
Shopping center Excluding caf, and laundry	l/square metre	7	
Shopping center Large dry goods	l/square metre	2	
Shopping center Large supermarket & meat department, no garbage grinder	l/square metre	3	
Shopping center Large supermarket & meat department, no garbage grinder	l/square metre	5	
Shopping center Small dry goods store	each	379	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Commercial/automobile			
Automobile gas station Vehicle served	vehicle	22	
Automobile gas station Add for catch basin in floor		372	
Automobile gas station Single house pump	unit	568	
Automobile gas station Double house pump	unit	1136	
Automobile gas station Island	island	1893	
Automobile gas station Vehicle served	vehicle	38	
Car wash	car	189	
Car wash	truck	378	
Commercial/hospitality			
Motel Bath&toilet only	person	118	
Motel Full housekeeping	person	180	
Motel Central bath	person	150	
Motel	unit	318	
Motel	housekeeping unit	454	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Motel Dinning room add	seat	122	
Motel Bar & lounge add	seat	68	
Motel Non residential staff add	employee	40	
Motel Bed&breakfast	person	27	
Hotel	guest	136	
Hotel Add for employees	employee	36	
Boarding house	resident	150	
Dormitory Bunkhouse	person	91	
Senior citizen home	resident	227	
Day Care Centers Staff & children	employee	73	
Industrial/Office			
Industrial buildings Excluding industrial waste, cafeteria and showers	employee	45	
Industrial buildings Excluding industrial waste, Including showers	employee	75	
Heavy Industry Excluding industrial waste, Including cafeteria&shower	employee	132	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Warehouse	employee	132	
Industrial Park	acre	63,644	
Industrial Park	employee	68	
Office No cafeteria	employee	50	
Office Including cafeteria	employee	76	
Town offices Office employees	employee	57	
Town Offices Transients	person	19	
Unspecified office space	square metre	613	
Recreation/Camping			
Campgrounds Tents only	site	181	
Campgrounds Trailers water&electrical	site	227	
Campgrounds Trailers water&sewer&electrical	site	284	
Campgrounds with central comfort stations	add for dump station per space	19	
Cabin resort	person	159	
Day camps No meal	person	38	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Day camps Meals	person	68	
Day camps Primitive camps	person	40	
Construction camps Flush toilets	person	189	
Construction camps No flush toilets	person	123	
Construction camps Migrant workers-central bathroom	person	123	
Youth camps	person	189	
Luxury camps	person	378	
Work camps	bed	227	
Cottages &small seasonal dwellings	unit	189	
Parks & Beaches and Picnic grounds			
Picnic & fairgrounds with bath houses showers toilets	person	38	
Picnic & fairgrounds with toilets only	person	18	
Beaches with showers & toilets	person	40	
Visitor Center	person	23	

Facility	Unit of measure	Minimum design flow Litres	Comments
Country Club			
Country club Resident present	person	372	
Country club Non resident	person	95	
Country club Showers in use	fixture	1800	
Country club Water closet	fixture	550	
Country club Lavatory	fixture	350	
Country clubs Urinals - hand flush	fixture	350	
Country clubs Showers	person	40	
Country clubs Day staff - Add	employee	50	
Recreation General			
Dance halls Washrooms only per day in use	square metre	11	
Dance halls Restaurants	seat	15	
Dance halls Bar	seat	10	
Dance halls Including bar & restaurant	patron	76	

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Theatre	seat	14	
Theatre Drive in - no food	space	11	
Theatre Drive in - food	space	23	
Theatre Fixed seat	seat	9	
Recreation/Sport			
Bowling Alleys Without bar & restaurant	alley	105	
Bowling Alleys With bar or restaurant	alley	800	
Ice rink	seat	11	
Ice rink Participant Add	person	38	
Stadium	seat	14	
Swimming pool	customer	14	
Swimming pool Area	square metre	50	
Water Slide Park	visitor	5	
Gym Participant	person	38	
Gym Spectator	person	11	
Tennis/Racquetball Excluding food	court	946	

Facility	Unit of measure	Minimum design flow Litres	Comments
Ski areas Without cafeteria	person	38	
Ski areas With cafeteria	person	57	
Outdoor sport facilities Toilet waste only	person	19	
Floor drains	unit	189	
Catch basins Garages, service stations etc	unit	375	
Residential	5 flushes per resident per day		
Schools	2 flushes per student per day		
Hotel/Motel room	4-6 flushes per guest per night		
Restaurant	0.5 flushes per meal per day		
General commercial	2-4 flushes per employee per 8 hr.		
Industrial	3 flushes per employee per 8 hr		
Ski Areas	1 flush per skier per day		
Campgrounds with facilities	3 flushes per person per night		
Public Restrooms Stay under 05 hr.	0.4 flushes per visitor per hr		
Public Restrooms Stay from 05 hr. To 1 hr	0.6 flushes per visitor per hr		

DESIGN WASTEWATER FLOWS			
Facility	**Unit of measure**	**Minimum design flow**	**Comments**
		Litres	
Public Restrooms Stay from1 to 2 hr.	0.8 flushes per visitor per hr		
Public Restrooms Stay over 2 hr.	1.0 flushes per visitor per hr		

APPENDIX G

CONVERSION TABLES

Conversions of guidelines numbers.

Metric unit	Symbol	Imperial units approximation
FLOWS		
1000 litres	1000 l	220 imperial gallons
1500 litres	1500 l	330 imperial gallons
LOT AREA		
2700 square metres	2700 m^2	29052 square feet
3150 square metres	3150 m^2	33894 square feet
3716 square metres	3716 m^2	39984 square feet
4500 square metres	4500 m^2	48420 squre feet
6800 square metres	6800 m^2	73168 square feet
9000 square metres	9000 m^2	96840 square feet
DEPTH OF PERMEABLE SOIL		
900 millimetres	900 mm	35.43 inches
600 millimetres	600 mm	23.6 inches
300 millimetres	300 mm	11.81 inches
150 millimetres	150 mm	5.9 inches
CLEARANCE DISTANCES		
1 metre	1 m	3.28 feet
1.5 metres	1.5 m	4.92 feet
3 metres	3 m	9.84 feet
6 metres	6 m	19.68 feet
6.1 metres	6.1 m	20.00 feet
9 metres	9 m	29.52 feet

12 metres	12 m	39.36 feet
12.1 metres	12.1 m	39.68 feet
12.5 metres	12.5 m	41 feet
15.2 metres	15.2 m	49.85 feet
15 metres	15 m	49.2 feet
23 metres	23 m	26.28 feet
30.5 metres	30.5 m	100.04 feet
100 metres	100 m	328 feet
MINIMUM SYSTEM LENGTH		
25 metres	25 m	82 feet
15 metres	15 m	49.2 feet
33 metres	33 m	108.24 feet

UNITS CONVERSION TABLE

To obtain :	Multiply:	By:
Metres (m)	Feet (ft)	0.3048
Metres (m)	Millimetres (mm)	0.001
Metres (m)	Inches (in)	0.0254
Feet (ft)	Metres (m)	3.28
Inches (in)	Metres (m)	39.37
Millimetres (mm)	Metres (m)	1000
Litres (l)	Imperial gallons (igal)	4.54
Litres (l)	US gallons (gal)	3.78
Litres (l)	Cubic feet (cf)	28.316
Imperial gallons (igal)	Litres (l)	0.220
US gallons (gal)	Litres (l)	0.264
Imperial gallons (igal)	US gallons (gal)	0.83
US gallons (gal)	Imperial gallons (igal)	1.2
Cubic feet (cf)	Imperial gallons (igal)	0.1605
Imperial gallons (igal)	Cubic feet (cf)	6.229
Cubic metre (m^3)	Litres (l)	0.001
Litres (l)	Cubic metre (m^3)	1000
Square metres (m^2)	Square feet (sq.ft)	0.093
Acres (acre)	Square metres (m^2)	4047
Acres (acre)	Square feet (sq.ft)	0.00002296
Square feet (sq.ft)	Square metres (m^2)	10.76
Square feet (sq.ft)	Acres (acre)	43560
Hectare (ha)	Acre (acre)	0.40568

To obtain :	Multiply:	By:
Acre (acre)	Hectare (ha)	2.471
Hectare (ha)	Square metres (m^2)	0.0001
Square metres (m^2)	Hectare (ha)	10,000
Gram (g)	Pound (lb)	453.59
Pound (lb)	Gram (g)	0.0022
Milligram (mg)	Gram (g)	1000
Gram (g)	Milligram (mg)	0.001
Feet of water	Pounds/sq.inch (psi)	2.306
Pounds/sq.inch (psi)	Feet of water	0.433
Litres/square metres (l/m^2)	Imperial gallons/square foot (ig/sq.tf)	48.932
Imperial gallons/square foot (ig/sq.tf)	Litres/square metres (l/m^2)	0.020
Litres/metre (l/m)	Imperial gallons/foot (ig/ft)	14.914
Imperial gallons/foot (ig/ft)	Litres/metre (l/m)	0.067
Metres/day	Metres/second	86400
Metres/second	Metres/day	0.00001157
Feet/day	Metres/second	283,392

APPENDIX I

PROCEDURES FOR ABANDONING SEPTIC TANK SYSTEMS

APPENDIX I

RECOMMENDED PROCEDURES FOR ABANDONING SEPTIC TANK SYSTEMS

The procedures recommended are as follows:

A. Septic Tank Systems

- If structurally sound, the septic tank is to be filled with soil or rock fill.
- Organic material such as wood, roots, grass, leaves, must not used.

OR

- Remove or break up the septic tank and fill the resulting excavation with soil or rock.
- Usually the disposal bed portion of the septic tank system can be left in its existing state.

These measures must be taken in order to eliminate the possibility of future potential health or safety hazards from developing. Step 2, filling the tank with soil or rock, is necessary to prevent the possibility of the tank collapsing and caving in or of "floating" upward in the event of high water table conditions. Organic material must not be used in filling the tank because it will decay and generate toxic or possibly explosive gases as well as leaving voids.

APPENDIX H

STANDARD CROSS SECTIONS

Enclosed disposal systems cross sections can be used when submitting an on-site sewage disposal system application.

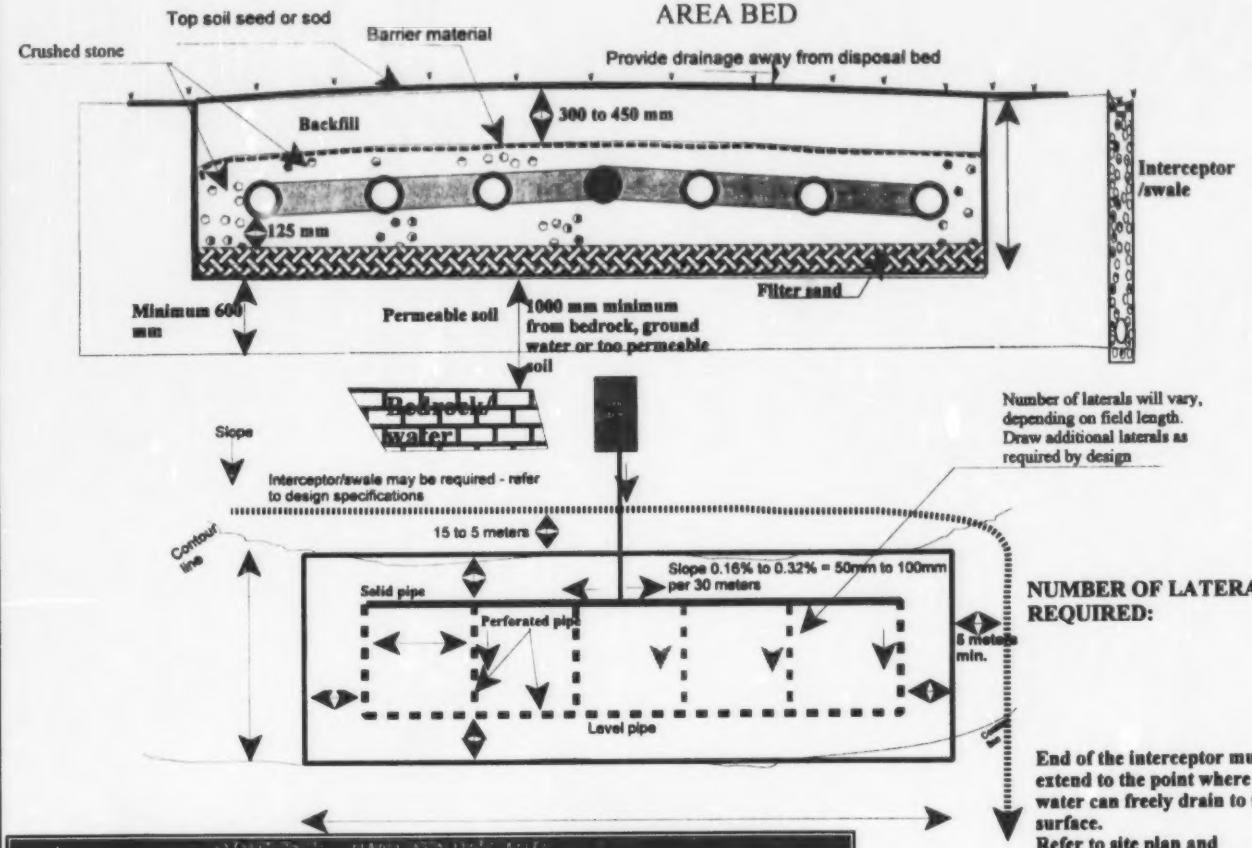
When enclosed cross sections are used , make sure that all pertinent information , such as buffer size, imported sand fill permeability, trench cut etc., is provided on the drawing.

When specific site conditions require a different cross-section than provided in this appendix submit an appropriate drawing and explain changes.

It is a Qualified Person responsibility to make sure that the selected type of disposal system is appropriate for the specific site conditions

SCHEDULE C

AREA BED


Top soil seed or sod
Barrier material
Crushed stone
Provide drainage away from disposal bed
Backfill
300 to 450 mm
125 mm
Interceptor /swale
Filter sand
Minimum 600 mm
Permeable soil
1000 mm minimum from bedrock, ground water or too permeable soil
Bedrock/ water
Slope
Interceptor/swale may be required - refer to design specifications
Number of laterals will vary, depending on field length. Draw additional laterals as required by design
15 to 5 meters
Contour line
Solid pipe
Slope 0.16% to 0.32% = 50mm to 100mm per 30 meters
Perforated pipe
8 meters min.
Level pipe
End of the interceptor must extend to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separation distances

NUMBER OF LATERALS REQUIRED:

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	**minutes at 20°C**	
	m	Interceptor swale depth		

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.

Disposal system must be installed by a contractor licensed to install on-site sewage disposal systems in Nova Scotia.

All work must be completed in accordance with a Nova Scotia On-Site Sewage Disposal Systems Regulations, On-Site Sewage SystemsTechnical Guidelines, and conditions of this approval.

Roof, foundation and lot drainage must be directed away from the disposal field, septic tank and pump (siphon) chamber.

Steps must be taken to ensure that the proposed disposal field areas are not subject to vehicular traffic or any other disturbance such as excavation or stockpiling of excavated material etc., installation of physical barrier is recommended.

It is applicants responsibility to assure that construction of foundations, driveway, well or any other development on the lot will not impact on feasibility of on site sewage disposal field installation.

Contractor is responsible for pump selection and installation (if pump is required by approval.)

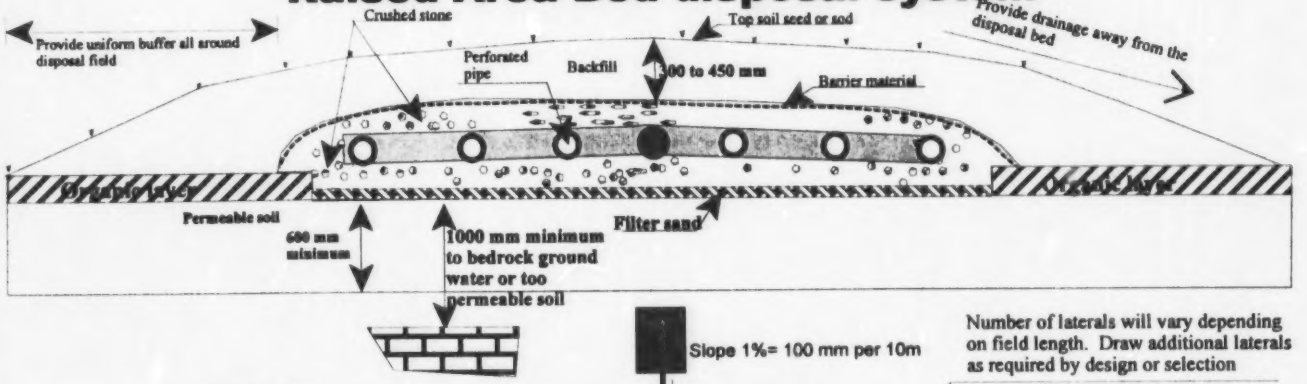
NOT TO SCALE

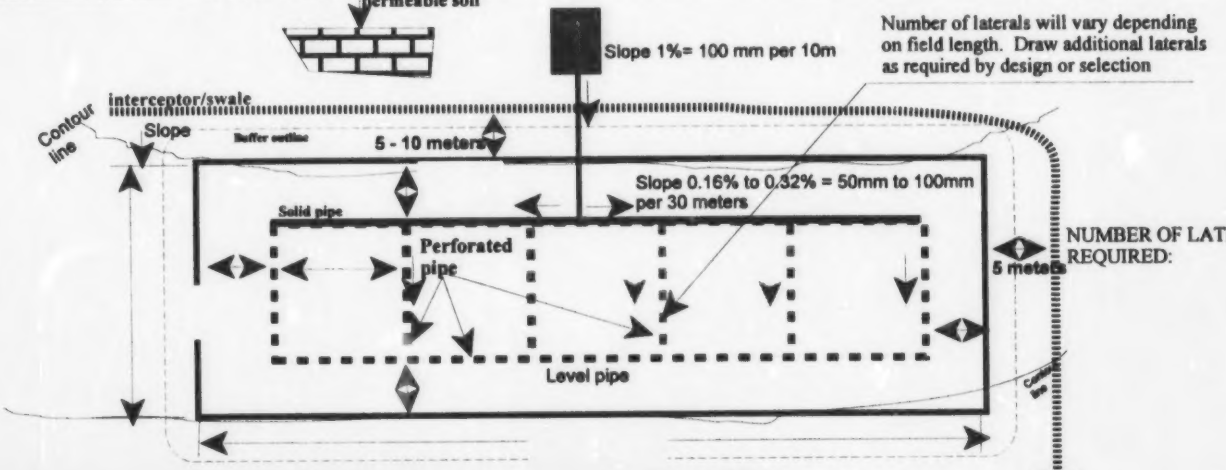
REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

SCHEDULE C

Raised Area Bed disposal system


Provide uniform buffer all around disposal field
Crushed stone
Top soil seed or sod
Provide drainage away from the disposal bed
Perforated pipe
Backfill
300 to 450 mm
Barrier material
Permeable soil
600 mm minimum
1000 mm minimum to bedrock ground water or too permeable soil
Filter sand


Slope 1%= 100 mm per 10m
Number of laterals will vary depending on field length. Draw additional laterals as required by design or selection
interceptor/swale
Contour line
Slope
Buffer outline
5 - 10 meters
Slope 0.16% to 0.32% = 50mm to 100mm per 30 meters
Solid pipe
Perforated pipe
NUMBER OF LATERALS REQUIRED:
5 meters
Level pipe
End of the interceptor must be extended to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separation distances

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	minutes at 20°C	
	m	Interceptor swale depth		

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.

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Steps must be taken to ensure that the proposed disposal field areas are not subject to vehicular traffic or any other disturbance such as excavation or stockpilling of excavated material etc., installation of physical barrier is recommended.

It is applicants responsibility to assure that construction of foundations, driveway, well or any other development on the lot will not impact on feasibility of on site sewage disposal field installation.

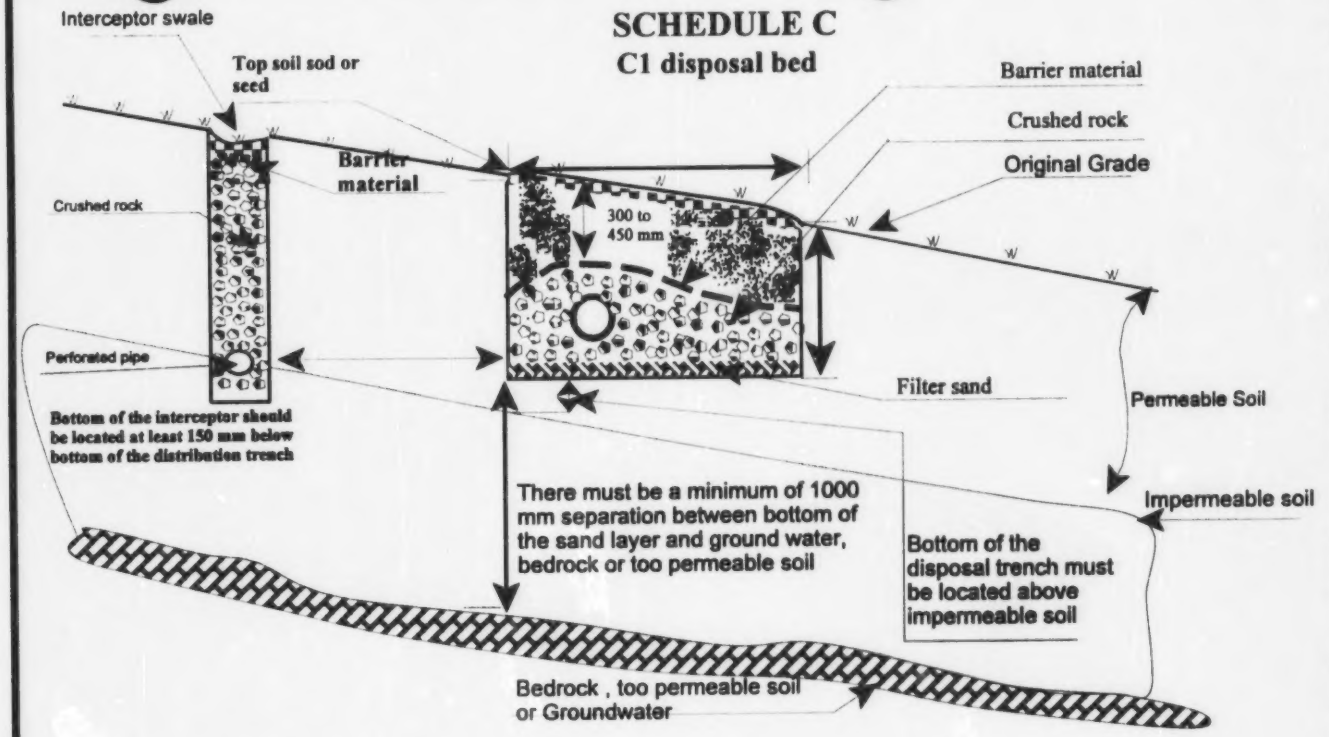
Contractor is responsible for pump selection and installation (if pump is required by approval.)

NOT TO SCALE

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

SCHEDULE C
C1 disposal bed


Interceptor swale
Top soil sod or seed
Barrier material
Crushed rock
Original Grade
Barrier material
Crushed rock
300 to 450 mm
Perforated pipe
Bottom of the interceptor should be located at least 150 mm below bottom of the distribution trench
Filter sand
Permeable Soil
There must be a minimum of 1000 mm separation between bottom of the sand layer and ground water, bedrock or too permeable soil
Impermeable soil
Bottom of the disposal trench must be located above impermeable soil
Bedrock , too permeable soil or Groundwater

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.

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It is applicants responsibility to assure that construction of foundations, driveway, well or any other development on the lot will not impact on feasibility of on site sewage disposal field installation.

Contractor is responsible for pump selection and installation (if pump required by approval.)

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	minutes at 20°C	
	m	**Interceptor swale depth**		

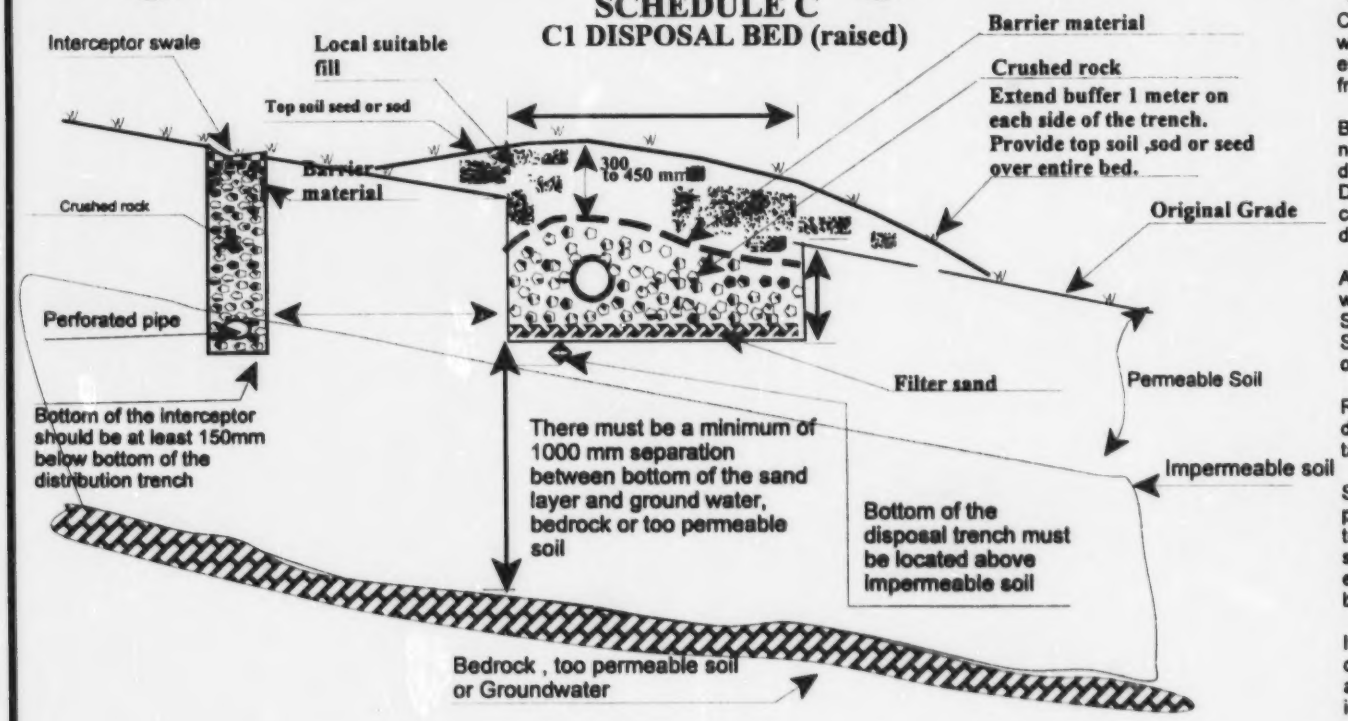
End of the interceptor must extend to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separattion distances.

NOT TO SCALE

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

SCHEDULE C
C1 DISPOSAL BED (raised)


Interceptor swale
Local suitable fill
Top soil seed or sod
Barrier material
Crushed rock
Perforated pipe
300 to 450 mm
Barrier material
Crushed rock
Extend buffer 1 meter on each side of the trench.
Provide top soil ,sod or seed over entire bed.
Original Grade
Filter sand
Permeable Soil
Impermeable soil
Bottom of the interceptor should be at least 150mm below bottom of the distribution trench
There must be a minimum of 1000 mm separation between bottom of the sand layer and ground water, bedrock or too permeable soil
Bottom of the disposal trench must be located above impermeable soil
Bedrock , too permeable soil or Groundwater

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.
Disposal system must be installed by a contractor licensed to install on-site sewage disposal systems in Nova Scotia.

All work must be completed in accordance with a Nova Scotia On-Site Sewage Disposal Systems Regulations, On-Site Sewage SystemsTechnical Guidelines, and conditions of this approval.

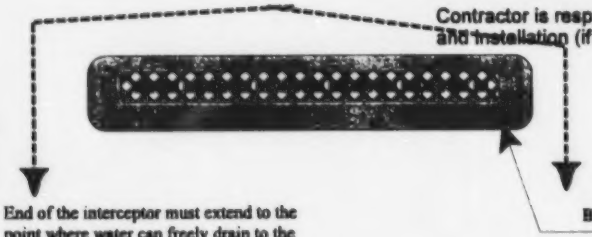
Roof, foundation and lot drainage must be directed away from the disposal field, septic tank and pump (siphon) chamber.

Steps must be taken to ensure that the proposed disposal field areas are not subject to vehicular traffic or any other disturbance such as excavation or stockpilling of excavated material etc., installation of physical barrier is recommended.

It is applicants responsibility to assure that construction of foundations, driveway, well or any other development on the lot will not impact on feasibility of on site sewage disposal field installation.

Contractor is responsible for pump selection and installation (if pump required by approval.)

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	**minutes at**	
	m	Interceptor swale depth		



NOT TO SCALE

End of the interceptor must extend to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separation distances.

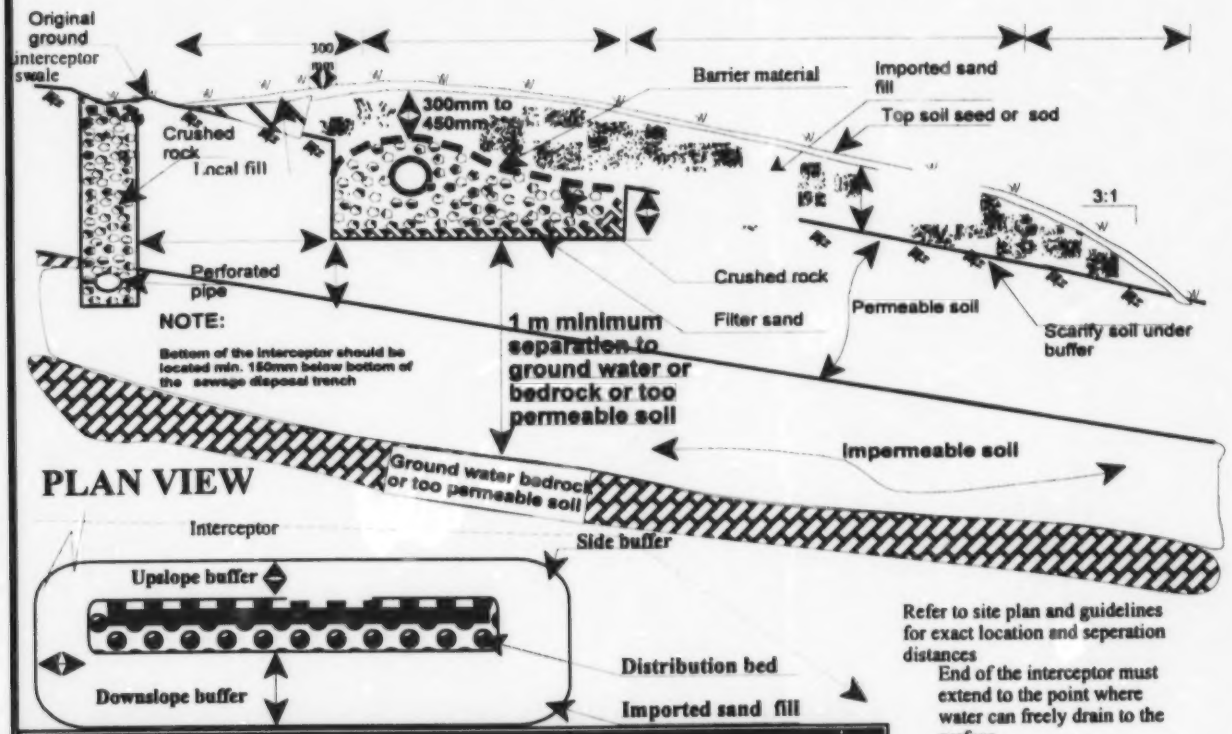
REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

SCHEDULE C
C2 CONTOUR DISPOSAL BED

Interceptor/swale must extend a minimum 5 m beyond each end of the disposal bed and must provide an adequate surface discharge point for the water

(Not to scale)



Refer to site plan and guidelines for exact location and seperation distances

End of the interceptor must extend to the point where water can freely drain to the surface.

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	minutes at 20°C	
	m	Interceptor swale depth		

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Disposal system must be installed by a contractor licensed to install on-site sewage disposal systems in Nova Scotia.

All work must be completed in accordance with a Nova Scotia On-Site Sewage Disposal Systems Regulations, On-Site Sewage SystemsTechnical Guidelines, and conditions of this approval.

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.

Roof, foundation and lot drainage must be directed away from the disposal field, septic tank and pump (siphon) chamber.

Steps must be taken to ensure that the proposed disposal field areas are not subject to vehicular traffic or any other disturbance such as excavation or stockpilling of excavated material etc., installation of physical barrier is recommended.

It is applicants responsibility to assure that construction of foundations, driveway, well or any other development on the lot will not impact on feasibility of on site sewage disposal field installation.

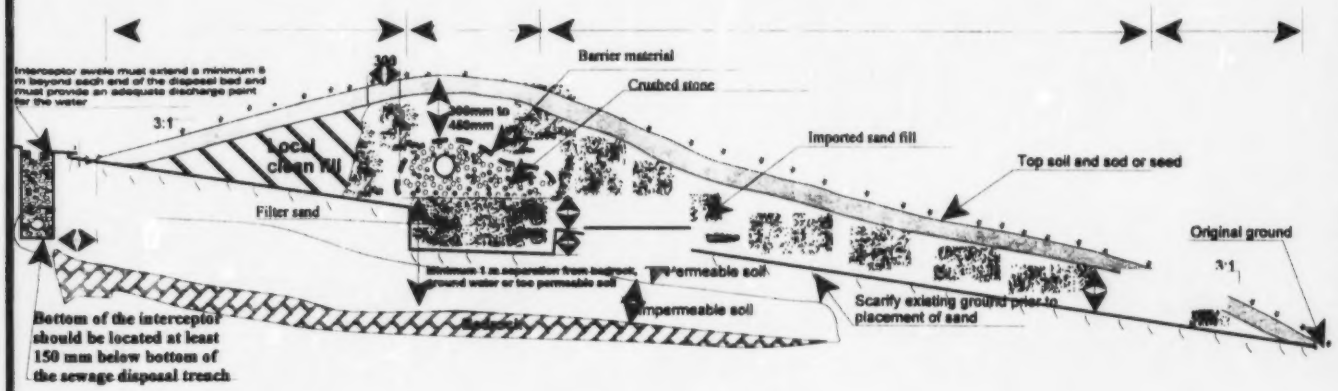
Contractor is responsible for pump selection and installation (if pump is required by approval.)

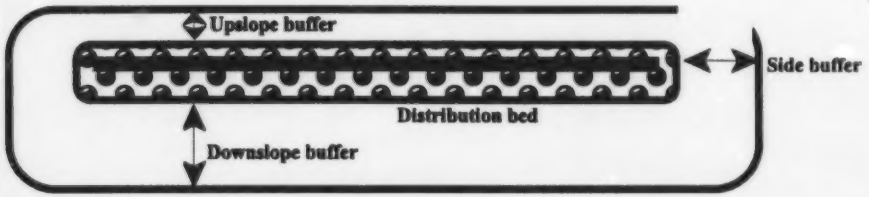
NOT TO SCALE

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

SCHEDULE C
C2 RAISED


Interceptor swale must extend a minimum 6 m beyond each end of the disposal bed and must provide an adequate discharge point for the water
300
Barrier material
Crushed stone
300mm to 450mm
3:1
Local clean fill
Imported sand fill
Top soil and sod or seed
Filter sand
Original ground
3:1
Minimum 1 m separation from bedrock, ground water or low permeable soil
Permeable soil
Impermeable soil
Scarify existing ground prior to placement of sand
Bottom of the interceptor should be located at least 150 mm below bottom of the sewage disposal trench



Refer to site plan and guidelines for exact location and separation distances.

End of the interceptor must extend to the point where water can freely drain to the surface

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	**minutes at 20°C**	2
	m	Interceptor swale depth		

General Conditions

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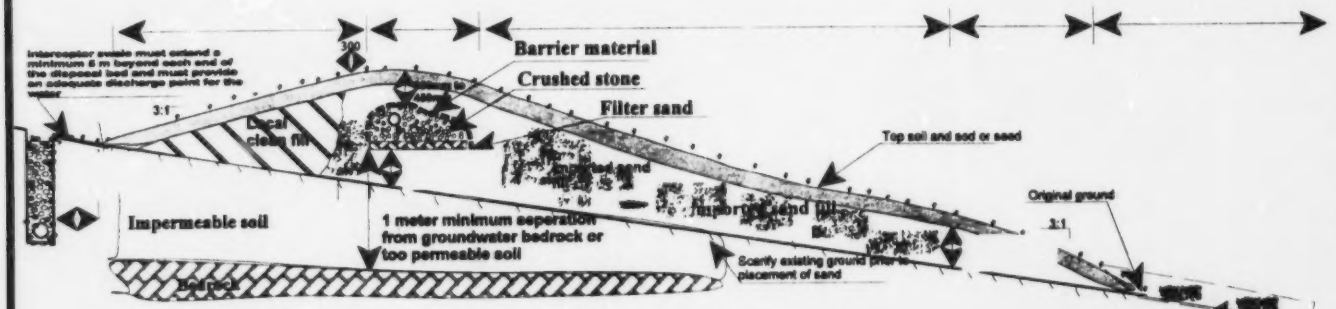
NOT TO SCALE

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

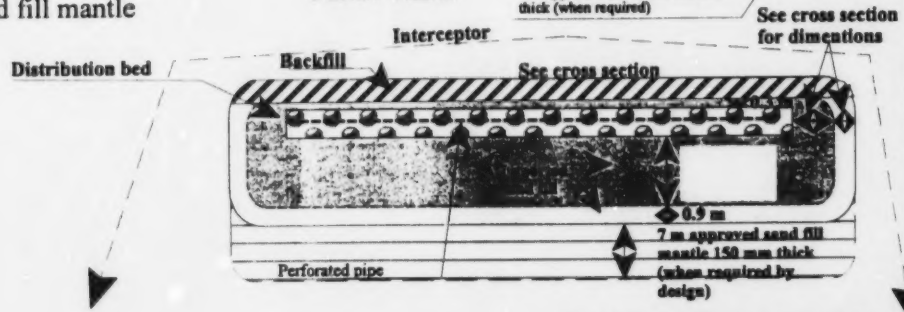
SCHEDULE C

C3 contour disposal bed


Barrier material
Crushed stone
Filter sand
Top soil and sod or seed
Original ground
3:1
Impermeable soil
1 meter minimum seperation from groundwater bedrock or too permeable soil
Scarify existing ground prior to placement of sand

Imported sand fill mantle requirement

PLAN VIEW


7 m approved fill mantle 150 mm thick (when required)
See cross section for dimentions
Interceptor
Distribution bed
Backfill
See cross section
0.9 m
7 m approved sand fill mantle 150 mm thick (when required by design)
Perforated pipe

End of the interceptor must extend to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separation distances.

	N/A	Top soil seed or sod
	mm	Clean local backfill
	N/A	Barrier material
	mm	Crushed rock above pipe
	mm	Perforated pipe diameter
	m	Perforated pipe length
	mm	Crushed rock below pipe
	mm	Filter sand
	m/s	Filter sand permeability **minutes at 20°C**
	m	Interceptor swale depth

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

Backwash water from water treatment must not be discharged to the on-site sewage disposal system.

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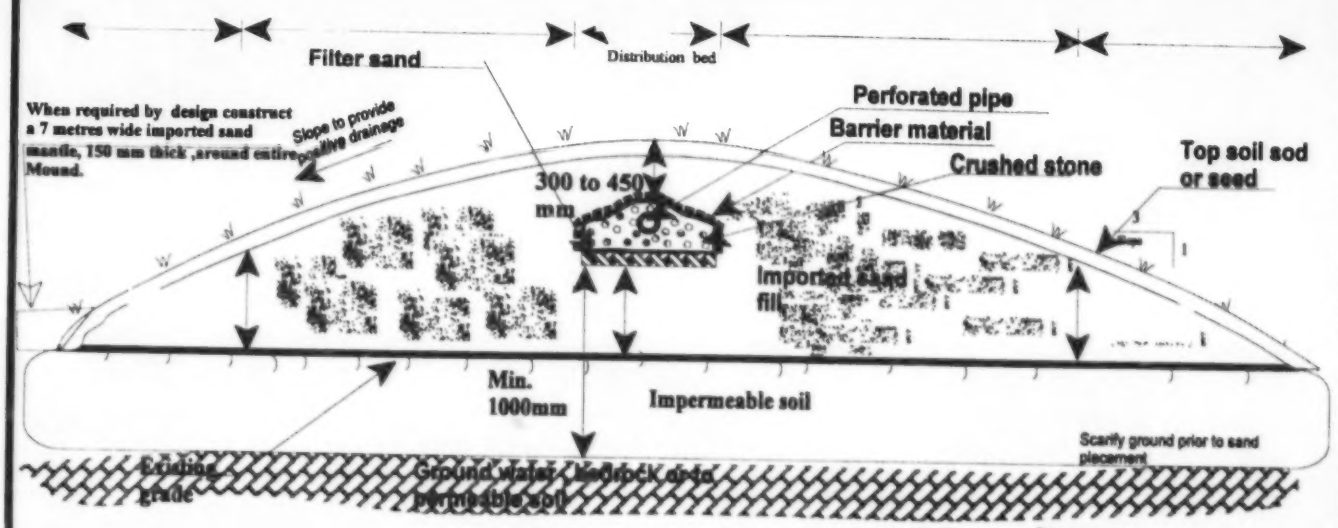
NOT TO SCALE

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

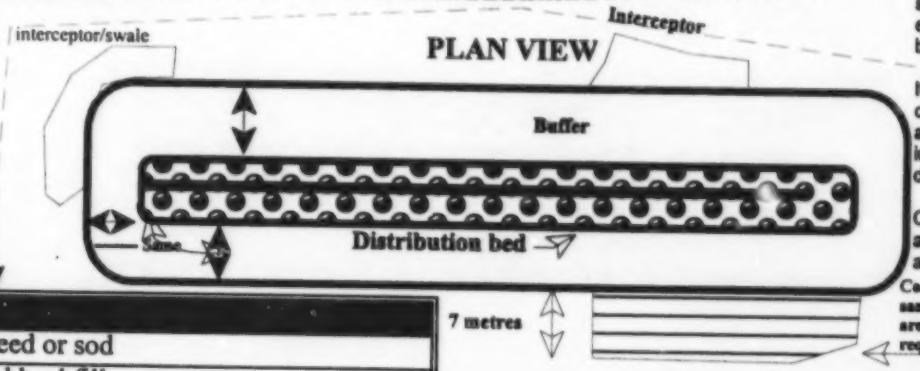
Applicant	
Approval No:	
Location	

SCHEDULE C
MOUND


Filter sand
Distribution bed
When required by design construct a 7 metres wide imported sand mantle, 150 mm thick ,around entire Mound.
Slope to provide positive drainage
Perforated pipe
Barrier material
Crushed stone
Top soil sod or seed
300 to 450 mm
Important sand fill
Min. 1000mm
Impermeable soil
Scarify ground prior to sand placement
Existing grade
Ground water / bedrock or to permeable soil

End of the interceptor must be extended to the point where water can freely drain to the surface.
Refer to site plan and guidelines for exact location and separation distances.

Imported sand fill mantle requirement



NOT TO SCALE

	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	**minutes at**	
	m	Interceptor swale depth		

General Conditions

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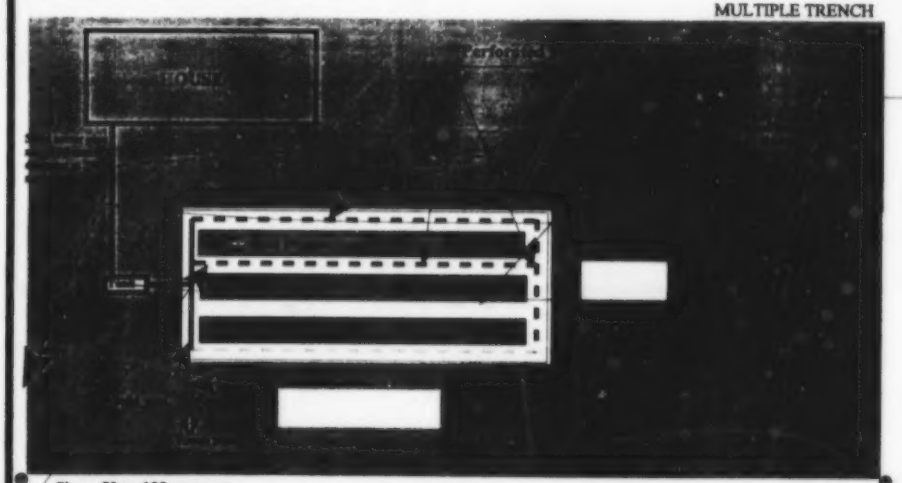
Contractor is responsible for pump selection and installation (if pump is required by approval.)

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

SCHEDULE C

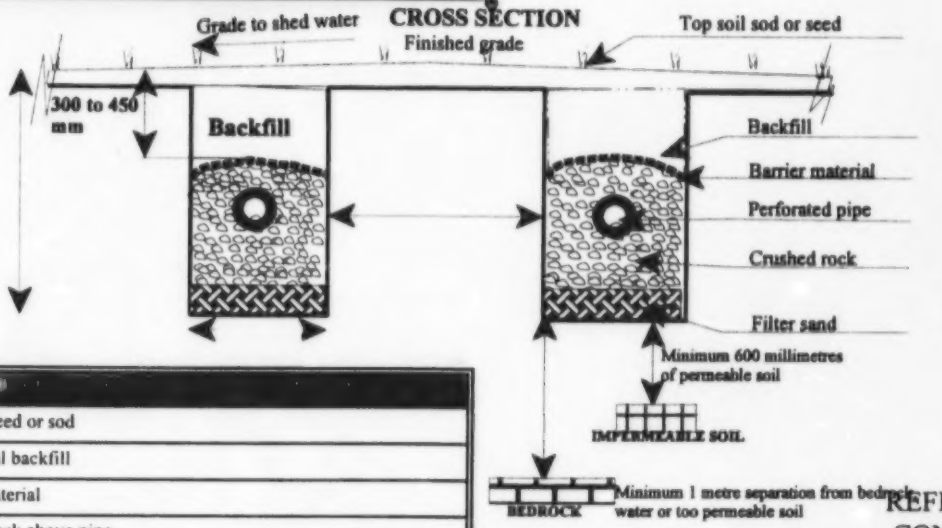
MULTIPLE TRENCH



Slope 50 to 100 mm per 30 m (0.16% to 0.32%)

Number of trenches will vary dependig on field size. Draw additional trenches as required by design

NUMBER OF TRENCHES REQUIRED:



	N/A	Top soil seed or sod		
	mm	Clean local backfill		
	N/A	Barrier material		
	mm	Crushed rock above pipe		
	mm	Perforated pipe diameter		
	m	Perforated pipe length		
	mm	Crushed rock below pipe		
	mm	Filter sand		
	m/s	Filter sand permeability	**minutes at 20°C**	
	m	Interceptor swale depth		

General Conditions

Contractor shall verify location of all wells, watercourses, lot boundaries and all elevations prior to construction (within 30.5 m from the location of disposal system)

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Contractor is responsible for pump selection and installation (if pump is required by approval.)

NOT TO SCALE

REFER TO GUIDELINES FOR CONSTRUCTION DETAILS

Applicant	
Approval No:	
Location	

APPENDIX J

SUBMISSION STANDARDS AND FORMS

SUBMISSION STANDARDS

Enclosed in this appendix are submission standards and a submission form. Applicant can fill out an enclosed form or provide typed report. In both cases it is important to provide all the information required by the submission standards.

NOVA SCOTIA Department of the Environment

" On-site Sewage Disposal System Interpretation Bulletin"

SUBMISSION STANDARDS FOR APPLICATIONS

All applications must comply with the Act, Regulations, Guidelines and any policies within the Department and shall include the following information:

Sketch of Property & Proposed Development

- Property lines
- Location of existing & proposed buildings
- Location and type of existing & proposed wells including neighbouring properties
- Location of watercourses, wetlands, marine waterbodies and other features that may influence the design of the system, including those located on neighbouring properties
- Existing & proposed driveways, roads, and walkways
- Location and type of disposal field
- Location of septic tank(s) and pump chamber(s)
- All clearance distances described in the regulations (variation maybe required)
- Location of test pits inspected on the property and any other testing locations such as in-situ permeability tests
- Direction of slope on property
- Percentage of slope of property

❑ Name and address of all owners of land abutting the proposed or existing lot(s)

Test Pit Log

- Recent weather conditions
- Total soil depth
- Effective soil depth
- Total depth of test pit
- Amount of organic layer
- Root penetration
- Depth to bedrock
- Depth to a layer that is unsuitable and/or impermeable(refer to guidelines)
- Determination of highest seasonal water table:
  - Presence and depth of mottling

- depth to water
- moisture contents (saturated, moist, dry, etc.)

Test Pit Log Cont'd:

- Soil profile:
  - Description of soil
  - Depth of each layer
  - Texture of soil (sandy silt, silty clay, etc.)
  - Moisture contents (saturated, moist, dry, etc.)
  - Density (1oose, medium compact, tight)
  - Colour

On-Site Sewage Disposal System

- Type of system:
  - C-1, C-2, C-3, area bed, multiple trench, mound, etc.
- Plan of system showing:
  - depth of trench
  - length of trench
  - width of trench:
    a) interceptor (if required)
    b) buffer zone widths (if applicable)
    c) type of pipe (N.S. spec. perforated pipe, solid pipe with holes drilled, etc.)
    d) hole spacing for holes drilled on site
- septic tank:
  - size of tank (liters)
  - type of tank pre-cast concrete, PVC, fiberglass, etc.)
- pump
  - size of pump chamber
  - amount to be discharged to disposal field
  - alarm (audible/visible)
- Cross section of system:
  - depth of front cut
  - width of trench
  - width of buffer (if applicable)
  - interceptor (if required)
  - depth of trench
  - amount of approved sand in trench
  - minimum amount of crushed rock under pipe
  - crushed rock over pipe

- geotextile
- amount and type of soil cover over geotextile
- depth and permeability of imported fill (if required)
- topsoil, seed or sod

Design/Selection Notes

- Type of usage to which the system will be subjected
- Projected flows (litres per day, gallons per day)
- Rationale for selection of system:
  - type of system (why C-2 was chosen instead of C-1, etc.)
- Length of system:
  - chart used to determine length
  - soil effective depth
- Estimated permeability:
  - measured permeabilty (if applicable)
  - slope of property
- Width of system:
  - chart or calculation used to determine width

SUBMISSION STANDARDS FOR APPLICATIONS FORM

All applications must comply with the Act, Regulations, Guidelines and any policies within the Department. A completed copy of this form should accompany each application.

APPLICANTS NAME:_____ **APPLICATION #:**_____
SUBDIVISION NAME:_____ **LOT NUMBER:**_____

SITE EVALUATION OF LOT

*Sketch of lot, location of soil evaluation tests, direction of slope, watercourse and other features that may influence the selection or design of the system.

SOIL EVALUATION TESTS

TEST PIT PROFILE (M)

TOTAL DEPTH:	M
BEDROCK AT:	M
WATER TABLE:	M
SLOPE:	%
ROOTS TO:	M
MOTTLING AT:	M

Permeability of soil in-situ:	
Flow rate:	
Test method:	

SOIL STRATUM	SOIL TYPE	DEPTH OF SOIL (mm)	DENSITY	MOISTURE
ORGANIC	organic mat			
1ST layer				
2ND layer				
3rd layer				

APPLICANTS NAME:_____ **APPLICATION #:**_____

SYSTEM SELECTION CRITERIA			
Daily flow	**Soil Type**	**Soil permeability**	**Depth of permeable soil**
Litres/day:_____		**m/s:**_____	**mm:** _____

SYSTEM SELECTION FROM TECHNICAL GUIDELINES			
Type of Disposal Field:		**Imported sand fill required**	❑ YES ❑ NO
Dimensions:	_____ L x _____ W	**Permeability Rate**	_____ **m/sec**
Cut at Toe of Trench:	**mm**	**Width of Buffer** -downslope -upslope	 **M** **M**
Interceptor Trench	❑ YES ❑ NO depth:_____	**Depth of Buffer**	_____**mm**
Pump or Siphon Capacity	_____**Litres**	**Septic Tank Capacity**	_____**Litres**

DRAWING OF PROPOSAL

* Sketch of On-site Sewage Disposal System Selection/Design

* Cross sectional diagrams of proposal to be attached to this form for submission.

DATE:_____ **QUALIFIED PERSON:**_____
(SIGNATURE)

CERTIFICATE OF QUALIFICATION #:_____ _____
(PRINT NAME)

N NOVA SCOTIA Department of the Environment SDOE dated February 4, 2000

SUBMISSION STANDARDS FOR FINAL INSPECTIONS

- **Owner Information**
  - Approval number
  - Name of applicant
  - Address of owner
  - Location of lot
  - Lot number
  - Date of installation

- **Installer/Designer/Selector**
  - Name of installer
  - License number of installer
  - Name of designer/selector
  - License number (if applicable)

- **Type of System Installer**
  - Multiple trench
  - Area Bed
  - C1, C2, C3
  - Mound
  - Other

- **Materials**
  - Pipe:
    - i) type (perforated, solid pipe with holes drilled, etc.)
    - ii) diameter
    - iii) length
    - iv) hole spacing if holes were drilled on-site
    - v) conforms to CSA Standards
  - Crushed rock:
    - i) amount placed
    - ii) meets regulatory approval

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- **Materials**

  - Barrier Material
    - approved type

  - Importer Fill:
    i) amount placed
    ii) certified by installer as meeting technical guidelines
    iii) certified independently as meeting technical guidelines
    iv) tested on-site by qualified person

  - Filter Sand:
    i) amount placed
    ii) certified as approved
    iii) certified independently as approved
    iv) tested on-site by qualified person

  - Interceptor Ditch:
    i) required
    ii) to be constructed
    iii) swale required

  - Septic Tank:
    i) type
    ii) size
    iii) conforms to CSA standards

  - Pump Chamber:
    i) discharge capacity
    ii) total volume
    iii) alarm (audible/visual)

  - Water Supply
    - type and location

- **Other**

- Sketch of installed system and location on lot:
  - i) distance of all portions of system (tank, disposal field) from important elements as outlined in the on-site sewage disposal system regulations
    - property boundaries
    - watercourses/wetlands
    - buildings
    - right-of-ways
    - drains/ditches
  - ii) slopes on pipe
  - iii) comments from qualified person that the system is installed in accordance to on-site regulations, technical guidelines and the terms and conditions of the approval